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DECEMBER, 1934

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PUBLIC WORKS PROGRAM TO BE EXPANDED



EVERY indication points to the continuation—on a larger and long-range basis—of the federal public works construction program.

¶ One clear indication of this intention is seen in a magazine article by Secretary Ickes, published under date of November 17, in which the expansion of the PWA is advocated.

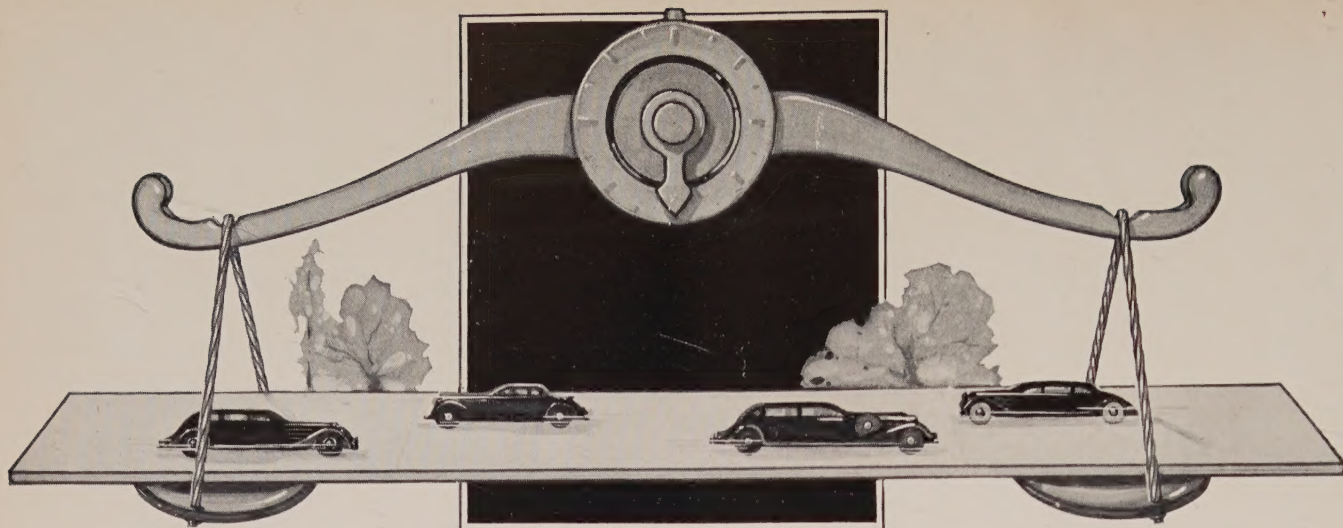
¶ Most assuredly, Secretary Ickes was not simply airing his own personal views in that magazine article. It must be regarded as representing the views of the national administration.

¶ This conclusion gains further force from the fact that the editor of the magazine in which the Ickes article appeared is close to the President, and is decidedly on the inside of things in Washington.

¶ The new Congress also seems to be overwhelmingly in favor of expanding public works construction. An Associated Press dispatch from Washington reports 64 per cent of the new members of Congress favoring such expansion, 33 per cent noncommittal, and only 3 per cent definitely opposed.

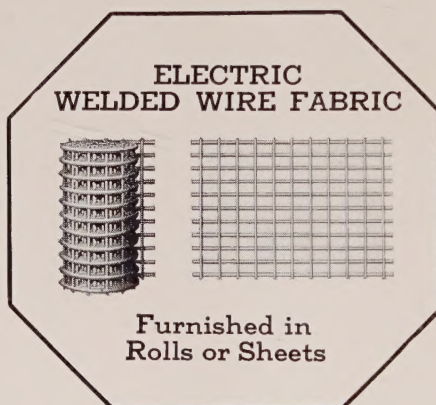
¶ Numerous news items emanating from Washington in recent weeks, from independent and from "inspired" sources, have carried the same implication — namely, that the federal government is preparing to inaugurate an enlarged public works program.

¶ At last, the powers at Washington are giving full recognition to the need for stimulating the heavy industries, and the construction industry in particular—an idea on which construction people have been hammering away since far back in the Hoover administration.

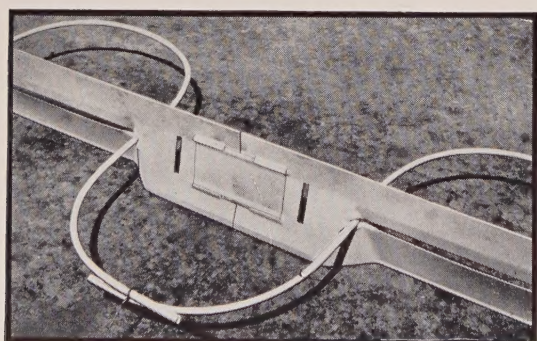


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Permeable Precast Concrete Jetties Designed to Prevent Scour

Create Sandy Beaches at Kenosha Through Control of Shore
Currents—Open Construction Reduces Velocity of Current
Without Diversion

By SYDNEY M. WOOD

Specialist in Shore Protection, Lake Bluff, Ill.

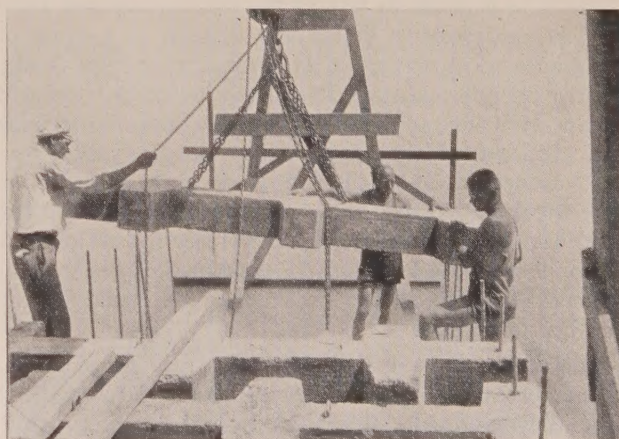
CONCRETE work of an unusual and interesting nature is now being done on the lake front property of the City of Kenosha, Wisconsin. Jetties, or groins, are being built from precast concrete blocks, the idea being to create a wide, sloping beach, which will serve in exposed regions as a protection against storms and high water.

Similar work has already been done, and is still in progress, at two other localities on Lake Michigan. One is at Shorewood, just north of Milwaukee, where the work has been carried on for some time as a relief project, and is now going on under the FERA. The other, a later development, is at Sheridan Park, Cudahy, Milwaukee County, Wisconsin, where eleven jetties are being built as a CCC project.

Basic Principles of Jetty Construction

These projects all have as their main objective the creation of a protective beach, and the fundamental principle underlying their construction and design is one that was discovered and developed by the writer some years ago, and is known as the principle of increasing permeability in groin construction. It is the claim of this method that to gain the best results in beach creation, groins built out into a body of water should be more and

more open in their construction as the outer or deep-water end is approached, and from the base to the top. In so doing the wind-generated littoral currents (those that travel along the shore) are slowed down in such a way that their sediment-carrying power is reduced, and sedimentation is thereby encouraged. It is a simple ap-



Placing precast concrete units in jetty construction at Shorewood, north of Milwaukee



Precast concrete units weighing a ton or more, placed in jetties at Kenosha, form open construction that reduces velocity of shore currents without diverting the current

plication of some of the elementary principles of hydraulics, the operation of Pascal's and Bernulli's laws being plainly in evidence.

Harmful Effects of Solid Jetties

Groin construction as a means of coast protection is a fairly old art, but the design in the old models calls for a groin that is impervious to water currents over its entire length. These currents are thus directly blocked. In order to continue their movement along the shore they are forced, as they approach the obstruction, to flow lakeward and parallel to the sides of the groin, and then pass to the leeward around the outer end, where, due to the pressure of the lake mass, the channel of the current is constricted. This results in an acceleration of velocity, with a great increase in the carrying power of the current. The rate of increase is well known, being in the order of the sixth power of the increase in the velocity rate.

As a result of this, under ordinary conditions, there is scour instead of deposit at the outer end of impermeable groins. Equally bad, or worse, is the effect on the lee side. The outward diversion of the littoral current causes a lakeward drift or undertow on this side. Thus the lee side is not only barred from its natural share of transient beach covering, but it is deprived of its reserves as well.

Increasing Permeability of Open Groin Construction

This is in contrast to one of the outstanding and revolutionary achievements of the new system. If a groin or jetty in its construction fairly approximates the fundamental principle that its permeability increases from zero at the water's edge to infinity at the lake end, the lee side owner under ordinary conditions no longer suffers; on the contrary, he is benefited a great part of the time. There are liable to be features of a special nature that would have to be considered in every locality, which may call for certain modifications in construction design; but the general principles invoked remain the same in any large body of water.

Under this new system of jetty or groin construction, which is patented, the littoral or shore current is utilized as a conveyor of sand with which to build beaches, while at the same time the current is not obstructed in such a way as to cause scour. The ideal structure, as suggested in the preceding paragraph, is one that offers less and less opposition to the current as the lakeward end is approached; and similarly, the opposition to the current at any one point must decrease from the bottom toward the top of the jetty. Both of these requirements for increasing permeability, or openness of construction, are realized in the precast concrete units employed in the work at Kenosha and elsewhere, previously mentioned.

The Precast Units

The blocks used in these concrete groins or jetties run a ton or more in weight, and are laid crosswise to the groin itself. On the lower courses their length is about 14 ft., which makes a safe and substantial base, 14 ft. in width. The upper courses taper to an extent which brings the deck to a width of 6 ft. The sides of the groin, therefore, have a slope which is very favorable for stepping down the energy of wave action. All these layers are bound together from the top to below the water surface by means of steel rods which are passed through holes

left in the precast blocks. There are lugs on all of the bars, and it is in the strategic placing of these lugs that the degree of permeability is controlled.

The design of the structure is such that there is little need of reinforcement after blocks are in place; but reinforcement is used, because it is generally necessary to move blocks which are only a few days old to make way for fresh castings. The mixture of concrete is about one part cement to about five parts of graded aggregate. The forms are of 2-in. and 3-in. lumber, and can be readily taken apart through the loosening of connecting bolts. The units are of a type which would also lend itself readily to the use of forms or molds made of metal or of material such as plywood, especially if designed for convenient assembly and removal. The units, as shown in one of the illustrations, consist of a beam-like principal member and several cross-arms, which give stability to the unit and obstruct the current.

One of the advantages of this type of construction lies in the fact that so much can be accomplished through the use of labor taken from relief rolls. It is, therefore, an undertaking that fits in unusually well with the present social trend that calls for federal or municipal absorption of slacks in the labor markets.

The groins serve other purposes besides shore protection, for their decks may be used as promenades, thus enhancing the recreational value of the beaches which their presence creates and maintains.

Coming Conventions

December 3-4—American Society of Agricultural Engineers, Farm Structures Division. Meeting. The Stevens, Chicago, Illinois. Raymond Olney, Secretary, St. Joseph, Michigan.

December 6-7—Highway Research Board, National Research Council. Fourteenth Annual Meeting. Roy W. Crum, Director, 2100 Constitution Avenue, Washington, D. C.

1935

January 5-13—St. Louis Modern Home Exposition. Exhibition Hall. St. Louis Municipal Auditorium. Lincoln G. Dickey, Director.

January 16-18—American Society of Civil Engineers. Annual. Geo. T. Seabury, Secretary, 33 West 39th St., New York City.

January 22-25—American Road Builders' Association. Convention and Highway Exhibit. Willard Hotel, Washington, D. C. Chas. Upham, Engineer-Director, National Press Building, Washington, D. C.

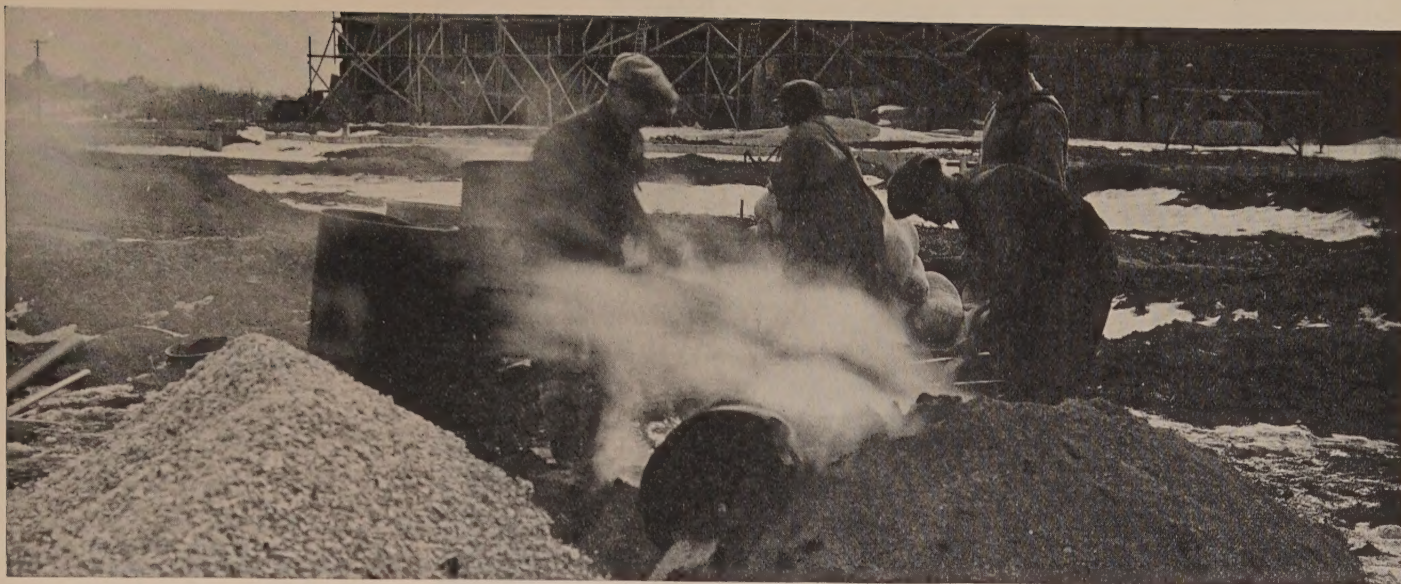
January 27-February 2—National Crushed Stone Association. Annual. Palmer House, Chicago. J. R. Boyd, Secretary, Munsey Building, Washington, D. C.

January 27-February 2—National Sand and Gravel Association. Annual. Palmer House, Chicago. V. P. Ahearn, Executive Secretary, Munsey Building, Washington, D. C.

January 27-February 2—National Slag Association. Annual. Palmer House, Chicago. H. J. Love, Manager, Earle Building, Washington, D. C.

February 16-24—Chicago Modern Homes Exposition, Inc. Coliseum. H. H. Potts, Manager, 1 N. LaSalle St., Chicago, Ill.

February 19-21—American Concrete Institute. Thirty-First Annual Convention. Roosevelt Hotel, New York City. Harvey Whipple, Secretary, 7400 Second Blvd., Detroit, Mich.



Heating concrete aggregates in stock piles. During colder weather the aggregates are covered with tarpaulins

Essentials of Winter Concreting

Boiled down to the fewest words, here are the main points to watch.

THE essential points about successful winter concreting methods, simply stated and boiled down to the limit of brevity, are given in the following numbered paragraphs taken from the practice recommended by one of the large cement manufacturing companies.

Winter Concreting Practice

1. *Quantity of Mixing Water:* Follow sound concreting practice; use no more water than required by placing conditions. This is even more important in cold weather than at normal temperatures.

2. *Heated Mixing Water:* Water may be heated by exhaust steam released at the bottom of the tank, by steam coils, or by direct-fired boilers. It pays to have more than enough hot water; only a large reservoir can deliver water at uniform temperature.

A low-pressure boiler of ample size (mounted on skids if the mixer is moving), discharging into the measuring tank of the mixer, is desirable. Under severe conditions, it pays to protect the mixer tank. Excessive water temperatures should be avoided; 150 deg. is a good working limit—never exceed 180 deg.

3. *Heated Aggregates:* Aggregates should be heated with care; dry heat and excessive temperatures should be avoided. The soundest method is to store the aggregate in compact piles, underlaid with perforated low-pressure steam pipes. Given sufficient time, the exhaust steam will raise aggregate temperature uniformly and drive out all frost. Heat all parts of the pile thoroughly; under severe conditions cover the stock piles.

Be sure aggregates are fully heated when withdrawn from stock piles—systematic handling will prevent use of cold materials and minimize heat protection.

4. *Thorough Mixing:* It pays to mix thoroughly; additional mixing permits the use of less water for a given workability, and that means increased concrete strengths.

5. *Prompt Placing:* Mix the concrete as close to point of deposit as possible. Transportation from mixer to work should be studied. Move the concrete no further than necessary—avoid delays—guard against heat loss en route.

Spread, compact and finish concrete promptly—then apply protection immediately. Early strengths depend upon the speed with which concrete is placed and protected—heat losses are highest during the first hour.

6. *Heat of Hydration:* All concrete generates heat, due to the hardening action of the cement; some cements generate this heat rapidly, others slowly. Special low-heat cements should not be used in cold weather, as their rate of hardening is slow. This heat, if held in the concrete, greatly assists hardening.

7. *Protection:* Protection against heat losses should be adequate to maintain the desired concrete temperature at all points in the structure for the full time required.

Methods vary with type of structure and exposure. Wet burlap, heavy beds of straw—plus canvas coverings in cold, windy weather—are used effectively to protect mass structures, even highway pavements.

Canvas inclosures containing heating apparatus, such as perforated steam pipes or salamanders, are used for bridges, buildings and similar structures. Costly wood housings are unnecessary.

Care should be exercised to protect exposed portions of small or moderate mass and exterior vertical surfaces. Pilasters, especially at the base, lintels, buttresses and other exposed members, require extra protection and their own sources of heat in freezing weather.

Don't skimp on heat. Remember adequate temperatures maintained for a full day, are better than inadequate temperatures for several days. Guard against temperature drops—the low point before dawn and the unexpected change in weather.

8. *Curing:* Concrete has to be kept moist in order to
(Continued on page 20)



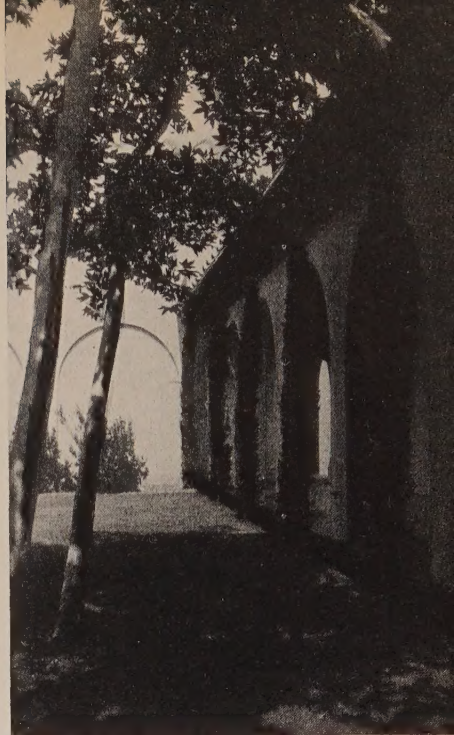
Left: Entrance detail,
George S. Stoneman
School, shows surface treat-
ment of monolithic con-
crete walls



Below: An architectural
style that harmonizes with
its surroundings

Show Character of Concrete in School Architecture

George S. Stoneman School Is Notable
Example of Architectural Adaptability
of Monolithic Concrete



Arcade, George S. Stoneman School

MONOLITHIC reinforced concrete as an architectural material seldom has shown itself to better advantage than in the George S. Stoneman School at San Marino, Calif.

Several of the illustrations provide close-up views of the exterior walls, from which the method of surface treatment and the effects obtained may be seen quite clearly.

Surface Treatment

The method here followed has been employed in a number of notable structures on the Pacific Coast and elsewhere. The practice is to leave the concrete exterior just

as it comes from the forms, so as to maintain and utilize the rugged character of the material. As soon as the forms are stripped the surface is brushed vigorously with wire brushes, to remove any dirt adhering to it. Holes or honeycombs occurring in the wall surface are filled with mortar from a batch of concrete of exactly the same mixture as that used in the wall.

In some instances no treatment of any kind is given to the surface after the forms are removed, aside from the wire brushing and filling of holes just mentioned. In other cases a further step is taken, as in the building here illustrated. In this instance the surface was given a very light dash coat of a tan-colored portland cement stucco, not enough to conceal the form marks, but sufficient to provide a most interesting surface texture. Usual practice calls for a mixture composed of 1 part of cement and $1\frac{1}{2}$ parts of sand, mixed to a creamy consistency. The dash coat is thrown on forcibly with a dash brush.

Other forms of treatment of the raw surface include the application of cement paints or cement wash.

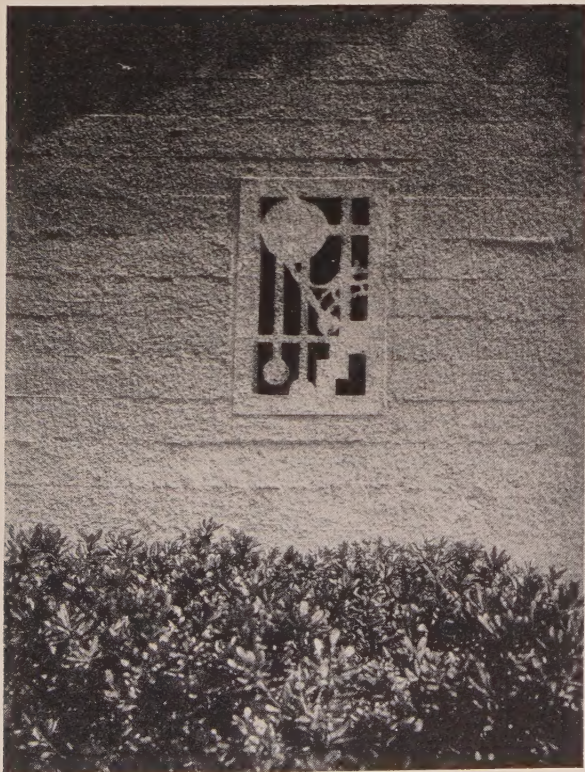
Wide Variety of Effects

Because of the wide variety of colors available, ranging from pure whites to creams, tans, and various shades of blues, reds and greens, these methods of surface treatment with cement paints, cement wash, or light stucco dash offer an almost unlimited number of color and texture effects. Through such methods the exterior surface can be dressed up without destroying its rugged character.

Care in the proportioning, mixing and placing of the concrete, and equal care in the erection of form work and in the selection of form material, enable the skillful designer to achieve the most artistic results in an economical manner and to obtain effects which, ten years ago, would have been regarded as quite impossible.

Form Work Must Be Detailed

As just suggested, special attention must be given to the detailing of the form work. This can not be left to the contractor—it must be done by the architect. For instance, several of the accompanying illustrations that provide



Decorative panel executed in concrete—"The mouse ran up the clock"

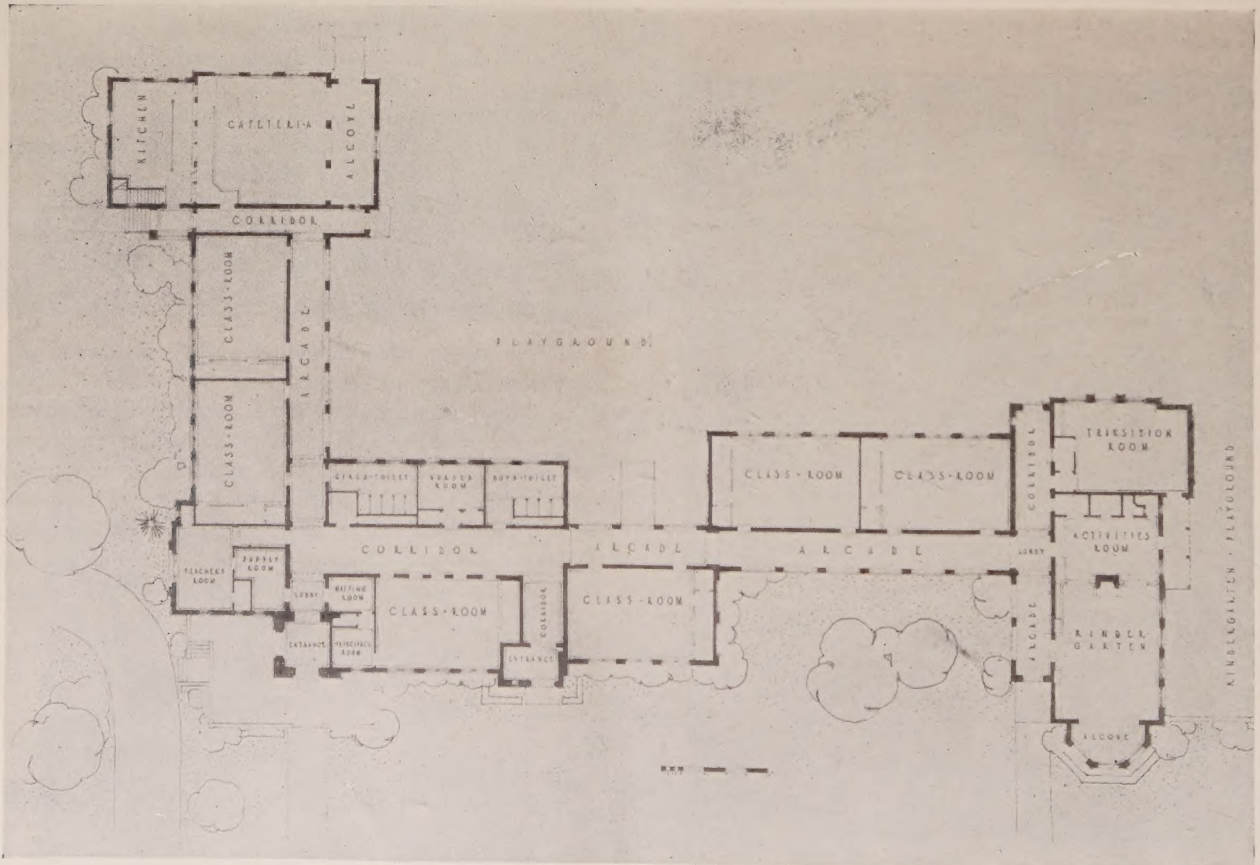


The kindergarten wing

close-up views of the exterior wall surfaces show that the form boards for these surfaces were all of the same width. Tongue-and-grooved stock is usually employed. Obviously, the form boards must be set exactly horizontal, and only selected material should be used. Boards of poorer qual-

ity can be used on surfaces that will not remain exposed in the finished structure.

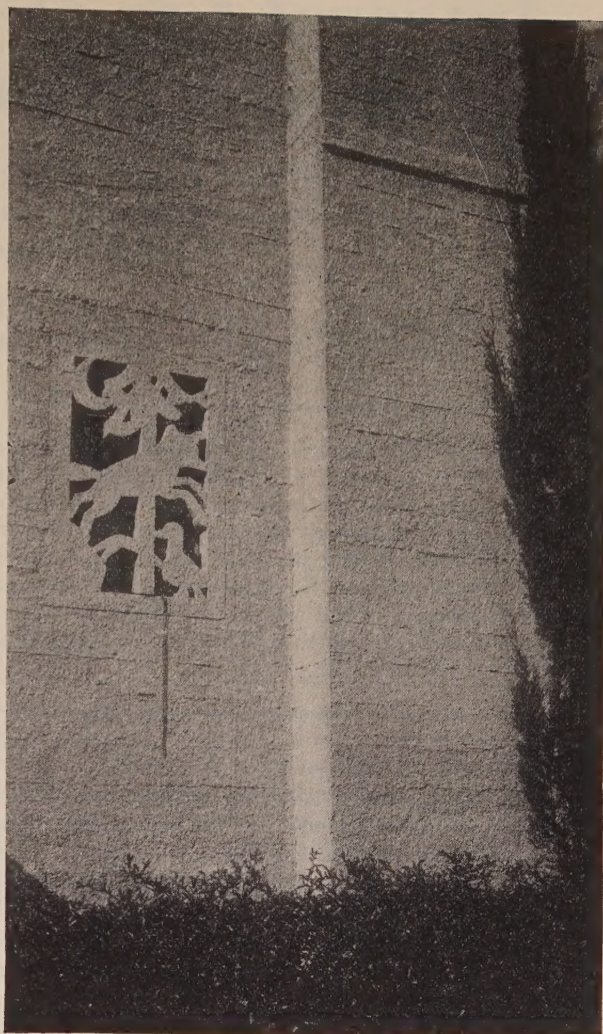
It is important, also, that oiling or painting of forms be avoided, because of the probability that oil will leave unsightly spots on the surface where the raw surface is



Plan of George S. Stoneman School



Wall surface and decorative panel—"Little Bo-Peep"



Decorative grille—"The fox and the goose," executed in concrete

given no further treatment; and where a dash coat of stucco or a coat of paint is to be applied, oil on the surface may prevent proper adhesion.

Proportioning, Mixing and Placing the Concrete

The concrete itself must be proportioned, mixed and placed in a manner that will produce a high degree of density, in order to minimize the absorption of water and possible damage from severe weather conditions.

The architect should definitely limit the amount of mixing water to not more than 6 gallons to the sack of cement. Then, after specifying suitable aggregates and certain limitations on proportions, he should allow the contractor the necessary leeway in working out the best mix. The exact proportions will depend to a considerable extent on the sizes and grading of the aggregates; but in general, the weight or volume of fine aggregate should be about two-thirds that of the coarse aggregate. This will produce a somewhat over-sanded mix, thereby going into place easily and producing a smooth surface. The amount and proportions of aggregates must be adjusted so that, at all times, the mixture will be plastic and will go into all the angles of the forms without requiring an excessive amount of spading. The mix should not be so wet that water will accumulate on top of a layer before it hardens.

When placing the concrete, it is very important that it be distributed evenly along the forms and not allowed

to flow horizontally to some other part of the wall. The forms must be filled evenly and, when possible, in one continuous operation. Any breaks in the placing of concrete should be made on well-defined lines previously determined by the architect—as, for instance, at floor levels.

The George S. Stoneman School is a masterpiece of school architecture, and the building is exceptionally well planned. The low, rambling character of the structure is in harmony with its surroundings. As the plan shows, there are six regular class rooms, a 3-unit kindergarten, a cafeteria and kitchen, three administration rooms, and the necessary wash rooms, corridor space, and so on. Basement space is provided only underneath the kitchen.

Low Unit Cost Proves Economy

The L-shaped building is, roughly, 234 ft. long and 132 ft. across the foot of the "L." The cubic content is 275,000 cu. ft. The total contract price, including the general contract, plumbing, electrical work, etc., was \$67,031, or about 24 cents a cu. ft.—a very moderate figure.

The building is almost entirely of reinforced concrete, this material having been used in all walls and in most of the floor construction. The roof framing, however, is built of wooden trusses.

Marsh, Smith and Powell, of Los Angeles, are the architects of this notable example of monolithic concrete architecture.

Integral Use of Calcium Chloride Supplies High Early Strength

Attain Marked Early Strength of Concrete—Both Standard and High-Early-Strength Cements Speeded Up—Value Shown in Cold-Weather Concrete Paving

By H. F. CLEMMER

Engineer of Materials, Department of Highways, District of Columbia, Washington, D. C.

A previous article by this author, published in the November (1932) issue of "Concrete" under the heading "Logical Use of Calcium Chloride in Pavement Concrete," discusses the early part of the investigation which, in the present article, is covered in greater detail and on the basis of later information. Particularly in the matter of field problems the present article goes into much greater detail than is true of the former one.—Editor.

A FACTOR of importance to all highway engineers, but particularly to those interested in the construction of pavements in congested traffic areas, is that of obtaining early strength of concrete—regardless of temperature—so that pavements may be opened to traffic at the earliest possible time, thereby reducing the expense of detours as well as relieving the congested traffic conditions which occur when detours are necessary.

The marked effect of temperature on the time required for concrete to attain a safe opening strength was clearly brought to the attention of the District of Columbia Highway Department by a correlation of the strengths of control specimens for an entire construction season, as plotted in part in Figure 1.

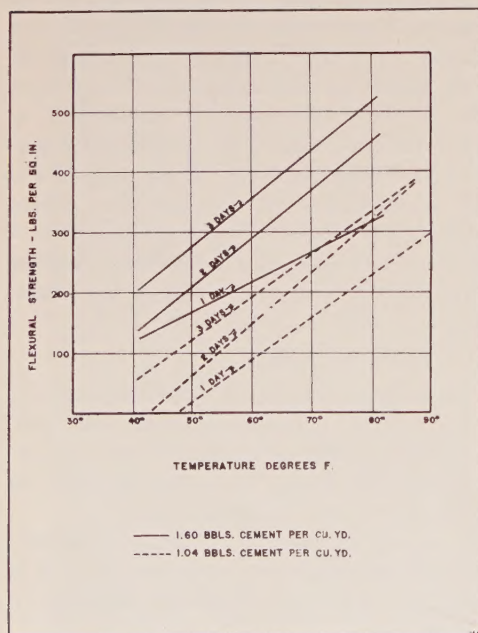


Figure 1. Showing time required to attain strength sufficient to permit opening of pavement to traffic

From paper presented before the Canadian Good Roads Association, October, 1934.

Due to this evidence, an extensive laboratory investigation was conducted with a view to obtaining data which would serve as a basis for designing pavement mixtures to obtain maximum strength in minimum time. The investigation included two distinct series of tests, one series being conducted under different uniform temperature conditions (40, 50, and 70 deg.), and the other under rising and lowering temperature conditions (60 to 40 deg., 40

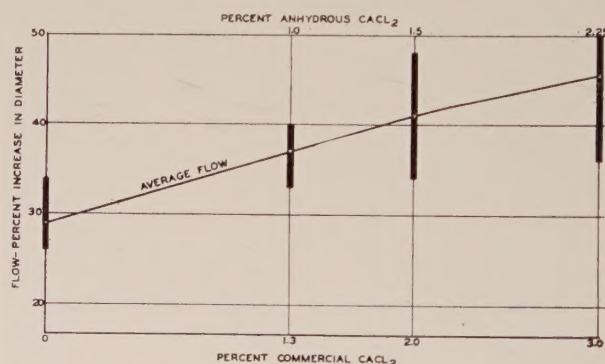


Figure 2. Calcium chloride permits lower water-cement ratio, because of increased workability

to 60 deg., etc.), so as to approximate more closely the actual temperature variations during the construction and curing periods of concrete pavements.

Calcium Chloride to Offset Low Temperatures

Realizing the value of accelerating the rate of hardening to overcome the effect of low temperatures on the early strength of concrete, calcium chloride was incorporated in the mix in order to determine the value of this accelerator for offsetting these adverse conditions. From investigations conducted by various highway organizations it was realized that this material functions as a curing agent as well as an accelerator, inasmuch as (1) data presented through the Highway Research Board by the Bureau of Public Roads* show that the use of calcium chloride controls volume changes from the time the concrete is placed; (2) research reported by Ohio State University** concludes that a more constant moisture content is maintained in concrete when calcium chloride is incorporated in the mix; (3) research reported by the U. S. Bureau of Standards*** and test results presented in Figure 2 of this paper show that a lower water-cement

*Tenth Annual Proceedings of the Highway Research Board, 1930.

**Bulletin No. 61.

***Thirteenth Annual Proceedings of the Highway Research Board, 1933.

ratio may be used, due to the fact that calcium chloride increases the workability of the concrete; and (4) the test results presented in Table 1 show that greater ultimate strength will be obtained by the concrete when calcium chloride is used integrally.

Length of Time before Opening

This investigation was outlined and conducted in such a manner as to determine the value of high-early-strength cement with and without calcium chloride; the value of standard portland cement, with and without calcium chloride; and the value of increasing the unit cement content in securing high-early-strength concrete at all tem-

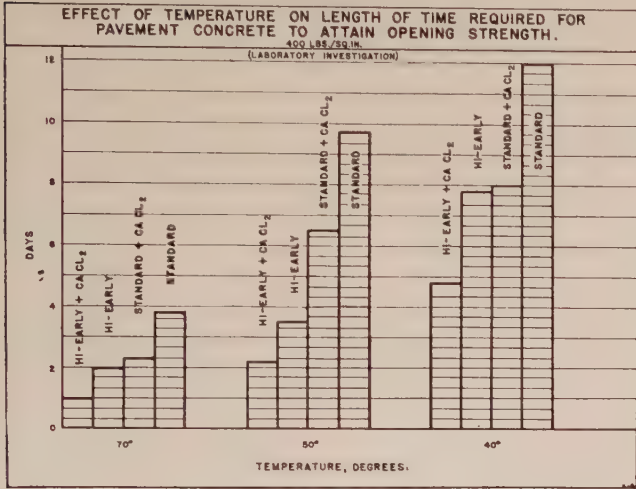


Figure 3. Effect of temperature on time required to attain sufficient strength to permit opening of pavement to traffic

peratures. Figure 3, taken from these investigational data, in which minimum opening time is plotted rather than the actual concrete strength, shows the following:

Concrete pavements placed at 70 deg. F. may be opened to traffic in one day when high-early-strength cement and calcium chloride are used; in two days when either high-early-strength cement, or standard portland cement and calcium chloride are used; and in four days when standard portland cement alone is used.

Concrete pavements placed and cured at 50 deg. F. may be opened to traffic in two days when high-early-strength cement and calcium chloride are used; in three days when high-early-strength cement is used alone; in six days when standard portland cement and calcium chloride are used; and in approximately nine days when standard portland cement alone is used.

Concrete pavements placed and cured at 40 deg. F. may be opened to traffic in five days when high-early-strength cement and calcium chloride are used; in eight days when high-early-strength cement, or standard portland cement and calcium chloride are used; and in approximately 12 days when standard portland cement alone is used.

A difference in temperature of 20 deg. F. (70 to 50) increases the minimum safe opening period one day; a difference of 30 deg. (70 to 40) increases this minimum opening period three days.

Both Early and Ultimate Strengths Increased

The temperatures discussed in this chart are such that heating of materials or providing enclosures to maintain high temperatures are seldom required, but as the data

show, there is a marked effect of temperature between the early strength of concrete placed at 70 deg. F. as compared to that placed at 40 deg. F. If maximum early strength is desired, heating of water or covering will materially increase the early strength attained by the concrete.

The U. S. Bureau of Standards has recently reported

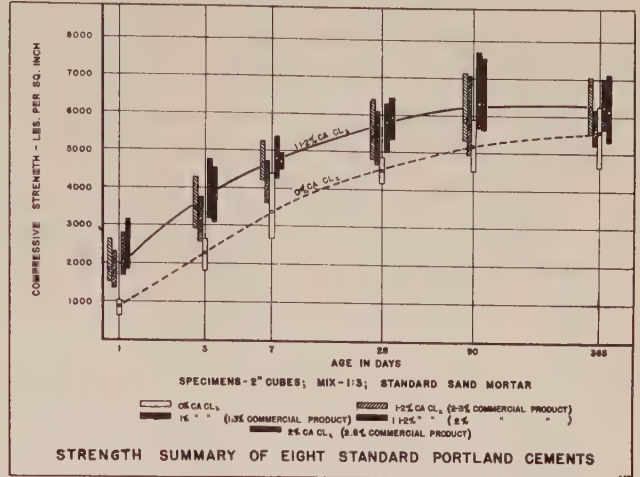


Figure 4. Ultimate strength, as well as early strength, is increased by integral use of calcium chloride

on an investigation as to the effect of calcium chloride on eight standard portland cements having the widest possible variation in composition. These data (Figure 4) show that the ultimate strength, as well as the early strength, of concrete is increased by the integral use of calcium chloride regardless of the brand of cement.

A comparison of the results of tests made by the Portland Cement Association, under the supervision of Pro-

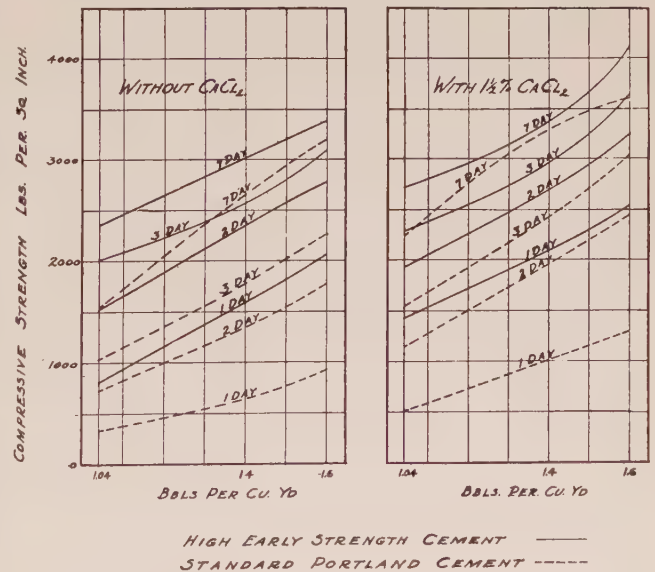


Figure 5. Early-strength effects of calcium chloride

fessor Abrams,* some years ago with those made by the District of Columbia, and those recently reported by the U. S. Bureau of Standards are shown in Table 1, from which the positive value of calcium chloride at all ages is readily apparent.

The Highway Department of the District of Columbia

*A. S. T. M., Vol. 24.

has found that by increasing the basic unit amount of standard portland cement and using calcium chloride a marked increase in early strength of the concrete is produced. A correlation of the results of field tests made during the past year under varying temperature conditions corroborates these laboratory data.

Since much of the concrete placed in highway construction has a comparatively low unit cement content, a series of tests was conducted to investigate the possibility of using various cement factors, as well as of using calcium

TABLE 1—COMPRESSIVE STRENGTH RATIO OF CALCIUM CHLORIDE INTEGRALLY CURED CONCRETE—COMPARED WITH IDEAL WET CURING (100%)

Age at Test	Portland Cement Assn.	District of Columbia	Bureau of Standards
1 Day	-----	180%	214%
2 Days	148%	152%	-----
3 Days	-----	146%	162%
7 Days	125%	121%	129%
28 Days	107%	-----	114%
3 Months	107%	-----	107%
1 Year	112%	-----	108%
3 Years	109%	-----	-----

chloride integrally, to assure the same strength at early ages for concrete placed at lower temperatures as that obtained with a specified amount of cement in concrete placed at 70 deg. F. (Figure 5).

Lean and Rich Mixtures Greatly Improved

The increase in early strength of concrete due to an increase in the unit cement content is shown by the results of the laboratory tests as plotted in Figure 5. Concrete containing 1.60 barrels of cement per cubic yard and cured at 70 deg. F. attained a 24-hr. compressive

Courtesy Canadian Engineer

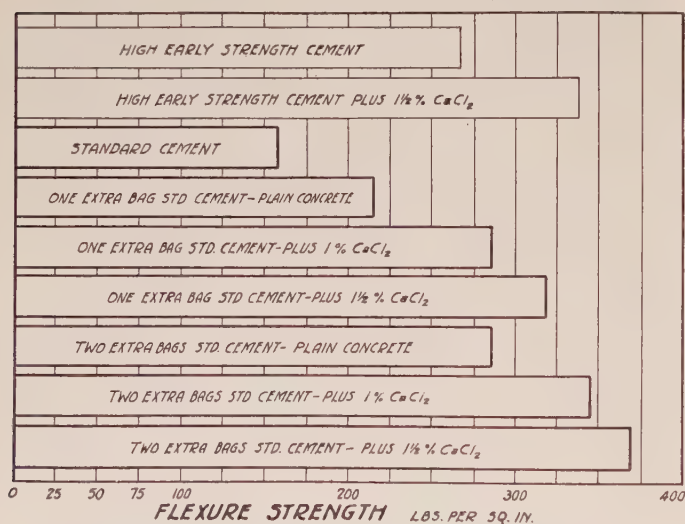


Figure 6. Showing effective use of calcium chloride to obtain specified opening strength of pavement in 24 hours

strength of approximately 900 lb. per sq. in. as compared to only 300 lb. per sq. in. for concrete containing but 1.04 barrels of cement per cubic yard. The use of calcium chloride increased the strength of the richer-mix concrete to 1,300 lb. per sq. in. at 24 hours as compared to 500 lb. per sq. in. for the leaner-mix concrete.

A program of tests similar to the foregoing was also conducted with three high-early-strength cements. The results indicated the same general effects of temperature

on high-early-strength cement concrete specimens as was noted on the standard cement concrete specimens.

Open Pavement in 24 Hours

Test results from a recent investigational field project, as plotted in Figure 6, in which an effort was made to obtain concrete having a specified opening strength in twenty-four hours of 300 lb. per sq. in. (flexure, base concrete) shows the results to be in agreement with those anticipated from a study of the previous laboratory investigation. It will be noted that increasing the unit cement content from 1.04 to 1.25 barrels per cubic yard and using 1½ per cent of calcium chloride, by weight of the cement (a) produced as high-early-strength concrete as using the basic amount of high-early-strength cement and

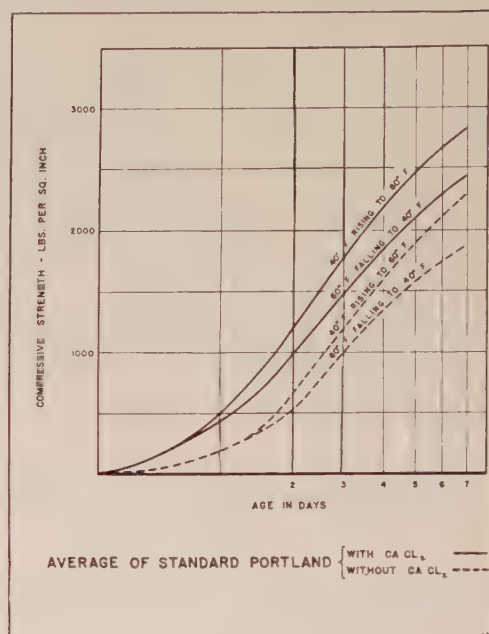


Figure 7. Favorable effect of placing concrete during rising temperature

calcium chloride, and (b) produced a better concrete from a durability consideration.* Under the conditions prevailing in this locality at the time of construction, the use of additional standard cement and calcium chloride also provided an economical saving.

When Placed During Rising or Falling Temperatures

The effect of raising and lowering temperatures immediately after the placing of the concrete was found to be a factor of striking significance.

Tests on concrete specimens were made with a series starting at 40 deg. F. and rising to 60 deg. F. Also, tests were made starting at 60 deg. F. and lowering to 40 deg. F. These cycles required 24 hours for completion, 12 hours falling or rising to the stated temperatures, and 12 hours rising or falling to the original temperature. Seven complete cycles were made in each case.

It will be noted (Figure 7) that the concrete placed at 40 deg. F. on a rising temperature to 60 deg. F., attained greater early strength than that placed at 60 deg. F. on a lowering temperature to 40 deg. F. This fact is pertinent in considering recommendations for special provisions for winter concrete construction.

*"Durability of Concrete," Highway Research Board, 1930.

(Continued on page 28)

EDITORIAL

Nothing Difficult About It

Canadian construction people tell us that they recognize no difficulty about placing concrete work in the coldest winter weather. They regard it as an every-day job—one that adds a little to the cost, but not nearly as much as it would cost to shut the job down for the winter.

As a matter of fact, Canadians learned how to place concrete in cold weather because they had to learn it. With their long winters it was quite out of the question to confine all concrete construction operations to the summer months. So they developed the necessary construction procedure for placing concrete during the coldest weather, regardless of the calendar or of outside temperatures.

While the essential rules of winter concreting are more widely known and more scrupulously observed among Canadian construction people than is the case in this country, the rules themselves are no different.

Regardless of the locality, the mixing water and the aggregates must be heated during those parts of the year when very cold weather can be expected. During the cool weather of spring and fall it may be necessary to heat only the mixing water. In all cases the newly-placed concrete must be covered or inclosed, and the inclosure must be kept warm and moist while the concrete is hardening.

These are the essentials of winter concreting. Detailed methods of procedure must be adapted to the character of the construction project involved, and to the materials and equipment at hand.

What is needed, above all things, is the Canadian attitude toward winter concreting, namely, that there is nothing difficult about it.

Co-operative Contracting

When bids were in preparation for the largest government contract ever awarded—the contract for Boulder Dam—six large construction companies decided to combine their equipment and their financial resources. They obtained the award under the name of Six Companies, Inc. The feeling back of this combination was that the contract was too large for a single company to undertake.

Now it develops that small building contractors can also combine to good advantage—not because prospective contracts are too big for one contractor to handle, but because of the desire to simplify negotiations with the owner.

But instead of an actual merger of equipment and financial resources, some small contractors are finding the co-operative method most satisfactory. Details of the method of procedure are given in an

article on page 20 of the November issue of "Concrete."

Concrete contractors who have made it a practice to take sub-contracts for concrete work on building construction projects might find the co-operative method more effective in landing jobs, and more economical to the owner.

As in all co-operative efforts, the selfishness of one individual may wreck the combination. One of the group may hatch the idea that he can put in an inflated bid and get away with it, while the others are trimming their bids to the bone.

In consequence, co-operative contracting organizations must provide definite channels through which offenders of this type may be expelled, and replaced with men who have a better sense of fair dealing. Otherwise, contractor co-operatives will not last long.

For Highway Engineers

A program of great value to highway engineers will be presented at the fourteenth annual meeting of the Highway Research Board, to be held in Washington on December 5, 6 and 7.

Particularly during the afternoon session of December 7, some highly interesting subjects related to the design and construction of concrete highways will be under discussion.

Among the papers scheduled for this session is one on the use of steel of high elastic limit for the reinforcement of concrete pavements. Another will discuss the chemical reactions between calcium chloride and portland cement.

Still another paper will be the report of the sub-committee on the relation of cement composition to the durability of concrete. This report is of especial significance because it demonstrates once more that engineers are displaying a growing interest in the chemical composition of cement.

It was not so long ago that users of portland cement regarded this material as a standardized product, and little attention was paid to differences in such matters as chemical composition and fineness distribution.

So far as ordinary concrete construction work was concerned, that idea was substantially correct. Now, however, engineers have developed the habit of looking into cement composition, and what it signifies, whenever they are dealing with structures that are to be subjected to special use, or to severe service, or to unusual climatic conditions.

In roads and street pavements concrete is subjected to severe service and to a great range of soil and weather conditions. It is logical, therefore, that highway engineers should inquire into the chemistry of cement.

PROGRESS—In a Page

◀ Current activities in research, in matters pertaining to concrete and cement, as being carried on or completed by various organized groups. ▶

Investigate Warping of Concrete Road Slabs

THE November (1934) issue of *Highway Research Abstracts* quotes from a report by W. V. Buck, state highway engineer, Kansas State Highway Department, telling of a current investigation of the warping of concrete pavement slabs. The warping was first observed on several projects in 1928 and has been under investigation since that time both in the field and the laboratory. Holes have been drilled through the slabs on a line four feet from the pavement centerline and at distances of 1, 5, 15, 30 and 50 ft. from transverse joints. The samples of subgrade taken through the holes were tested for density and moisture content, along with other physical and chemical tests. Precise levels have shown the actual movements of the slabs.

Classification of soils under warped slabs show them to be soils which might be called "border line" soils. They are clay soils with reasonably high shrinkage and usually contain 30 per cent or more of grain sizes below 0.005 mm. and 60 per cent or more smaller than 0.05 mm.

Indications from the investigation so far are that water enters the joint, causing increase in volume of the soil. As the distance from the joint increases, the moisture content decreases. The greatest warping occurs at the point of maximum subgrade moisture. In some cases where no edge curb was used, water penetrated the soil as much as four feet from the edge of the pavement, with consequent volume change sufficient to cause entire loss of crown and resulting in longitudinal cracking near the line of moisture change in the soil. Where an edge curb allows little water to enter along the edge of the slab, no such warping has occurred.

A detailed report will be made by the Kansas State Highway Department when the investigation has been completed.

Extensive Research Activities of A. S. T. M.

FOLLOWING is a synopsis of the extensive activities in various fields of research affecting the use of cement and concrete, now being conducted by committees of the American Society for Testing Materials:

Compressive Strength Test of Cement Mortars (Committee C-1).—Development of satisfactory commercial test for compressive strength of portland-cement mortars. Comprehensive investigation undertaken on 12 cements by 10 laboratories to study effect on results of refinements in proposed test procedure; relation between standard tension, concrete and plastic mortar strength results; the relative merits of standard Ottawa *versus* graded Ottawa sand for cube tests, to obtain data as basis of possible specification requirements; effect of rate of loading on results, and to secure voids-cement ratio as possible further refinement in test. Extensive data reported and tentative method prepared, see preprint, 1934 Report of Committee C-1.

Particle Size and Specific Surface of Cement (Committee C-1).—Development and studies of apparatus and procedures for determining sub-sieve gradation of particle-size and specific surface of cements. Turbidimeter developed at Cement Reference Laboratory of National Bureau of Standards, see L. A. Wagner, "A Rapid Method for the Determination of the Specific Surface of Portland Cement" *Proceedings*, Vol. 33, Part II, p. 553 (1933). Co-operative studies reported on 4 cements by 25 laboratories of this and other apparatus and methods, see preprint, 1934 Report of Committee C-1. Studies also reported by A. Klein on "The Suspension Turbidimeter for Determination of Specific Surface of Granular Materials," see 1934 preprint. Method developed by Committee C-1 for fineness tests of cement using turbidimeter to be proposed as tentative.

Concrete Curing Methods

THE following specifications for curing concrete, formerly holding the status of tentative standards of the American Society for Testing Materials, have been advanced to the status of full standards, with the serial designations indicated:

Curing Portland-Cement Concrete (C80-34).

Curing Portland-Cement Concrete Slabs with Bituminous Coverings (C81-34).

Curing Portland-Cement Concrete Slabs with Calcium Chloride Admixture (C82-34).

Curing Portland-Cement Concrete Slabs by Surface Application of Calcium Chloride (C83-34).

Curing Portland-Cement Concrete Slabs with Wet Coverings (C84-34).

Adoption of Tentative Specifications for Sodium Silicate for Curing Concrete (serial designation, C111-34T) was recorded on this page in the issue of September, 1934.

Revised Specifications for Concrete Pipe

THE American Society for Testing Materials has revised its specifications for several types of concrete pipe, the revised specifications having been adopted as tentative standards as the result of formal action taken since the last annual meeting.

The long-existing standard for Cement-Concrete Sewer Pipe (C14-24), adopted in 1924, is now superseded by the revised Tentative Specifications for Non-Reinforced Concrete Sewer Pipe (C14-34T).

The former tentative standard C75-30T is now superseded by the revised Tentative Specifications for Reinforced Concrete Sewer Pipe (C75-34T).

Concrete Building Brick

STANDARD Specifications for Concrete Building Brick (serial designation, C55-34) is one of a number of new full standards adopted by the American Society for Testing Materials. This full standard supersedes the tentative standard carried under the serial designation C55-33T.

Architectural Concrete



"The Pied Piper," one of the decorative panels, or grilles, in the exterior concrete walls of the George S. Stoneman School, San Marino, Calif. This unusual work was executed in reinforced concrete, lightly dashed with a tan-colored portland cement stucco which produced an interesting texture without eliminating form marks

MARSH, SMITH AND POWELL, *Architects*

Control Oxidized Hydrogen Sulphide to Prevent Sewer Failures

By M. W. LOVING

Secretary, American Concrete Pipe Association, 33 W. Grand Ave., Chicago, Ill.

When promotional propaganda stoops to outright misrepresentation of competitive materials, it has reached its lowest possible level.

This can be said of an article recently appearing in a journal covering the clay products industry, to which reference is here made. Specifically, failures or partial failures of important sewers built of clay block or clay brick are either ignored, or they are described in a way that leaves the reader to infer that they were built of concrete. The failure of 875 ft. of a lateral sewer of 18-in. concrete pipe, the cause of which is well known, is magnified to carry the sensational though absurd implication that 742 miles of concrete pipe sewer in Los Angeles must be eventually replaced.

In view of the misleading character of the article referred to, and the further fact that it has been reprinted and broadcast throughout the United States and Canada, the editor of "Concrete" requested M. W. Loving, Secretary of the American Concrete Pipe Association, who has made a thorough study of sewerage systems throughout the entire country, to give our readers the facts. Mr. Loving has done this in the article here presented.—Editor.

THE *Brick and Clay Record* of October, 1934, features an article entitled "Failures in Concrete Sewer Pipe Arouse Los Angeles," by G. B. Burnett, of Los Angeles. This article implies that 745 miles of concrete pipe have been or will be destroyed. It has been reprinted and broadcast throughout the United States and Canada by the manufacturers of clay products. The following statement, among others, is made:

"In 1899 Los Angeles acquired its first knowledge of the primary weakness of cement as a material for sanitary sewers. At that time the South outfall was decomposing from hydrogen sulphide gas (sewer gas) after 5 years of service. A cement concrete tunnel, which completed the outfall, was inspected in an investigation costing \$2,500 and found to be in such bad shape from gas attack that it was finally abandoned 10 years after installation."

First Outfall Sewer

Here are the facts: The first Los Angeles outfall sewer was placed in service in March, 1894. The sewer was 12.4 miles in length, consisting of 0.5 miles of 52-in., 2-ring, circular brick; 3.8 miles of 40-in., 2-ring circular brick; 1.5 miles of 6-ft. by 4½-ft. oval brick and concrete tunnel section (brick arch above the springing line and monolithic concrete below); 3.2 miles of 38-in. wood stave pipe, first inverted siphon; 3.2 miles of 36-in. wood stave pipe, second inverted siphon; and 0.2 miles of 24-in. cast iron pipe, subaqueous, discharging into the Pacific Ocean. The total cost was \$370,000. The design and construction are described in *Engineering News*, February 28, 1895.

Engineering News of November 8, 1900, presents a report of Homer Hamlin, Deputy City Engineer, describing the disintegration of the brick masonry above the flow line of the sewage. The theoretical velocity through the siphon was only 1.15 ft. per second, and 0.44 ft. per second through the tunnel section. Detention of the sewage in the first siphon and brick tunnel was more than eight hours. In flowing through the first siphon, the sewage was under pressure and therefore retained the gases in solution and when discharged into the junction chamber (before it flowed through the tunnel section), vast quantities of hydrogen sulphide were liberated. This, in turn, was oxidized to form sulphuric acid which promptly disintegrated the cement mortar joints, causing swelling and destruction of the brick masonry. Mr. Hamlin suggested a plan to cause the sewer to flow full, which would automatically solve the problem. This was never carried out and the sewer was abandoned, as mentioned by Mr. Burnett.

Second Outfall Sewer

The second Los Angeles outfall sewer, costing approximately \$1,000,000, was placed in service in 1907. It was built of brick construction with concrete mortar joints throughout, and varied in diameter from 3 ft. 3 in. circular to 6 ft. 1 in. high and 5 ft. wide. The theoretical velocity through this sewer varied from 4.2 to 7.8 ft. per second and is described in the *Southwest Contractor* of October 16, 1925, by W. T. Knowlton, Sanitary Engineer, of Los Angeles. On October 26 and 28, 1925, I interviewed Mr. Knowlton with reference to this sewer and was informed that at least one ring of the masonry had fallen in and, in all probability, the complete arch had been disintegrated by oxidized hydrogen sulphide. Mr. Knowlton pointed out that the distance of flow of the sewage from the upper reaches of the system to the outlet in the Pacific Ocean was more than 50 miles and the detention varied from 12 to 18 hours. The life of this sewer was undoubtedly prolonged because the sewer was overloaded and flowed full a considerable portion of the time. Its capacity, however, was considered inadequate and it was necessary to construct a third outfall, described below.

On October 10, 1934, I interviewed the officials of the city of Los Angeles and was informed that this sewer had been abandoned. Some consideration is being given to reconditioning the sewer with cement mortar in the form of gunite, so that it may function in an emergency as a storm sewer. The engineers of Los Angeles have thoroughly examined this sewer, and the accompanying photographs illustrate its condition today. I was further informed that throughout the service period of this sewer, at frequent intervals, it was necessary to gunite the sewer (with portland cement mortar) to prolong its life, due to both inadequate structural strength and disintegration by oxidized hydrogen sulphide.

Third Los Angeles Outfall

On August 29, 1922, a bond issue for \$12,000,000 was voted by Los Angeles citizens to cover the construction of a new outfall sewer. From the report of the Special Sewage Disposal Commission, consisting of the late George W. Fuller, 170 Broadway, New York, the late George C. Whipple, Professor of Sanitary Engineering at Harvard University, and William Mulholland, Consulting



Figure 1. Interior surface of the 42-in. clay segment block outfall sewer, Orange County, California. Swelling of mortar caused serious damage as shown. This is exactly what happened at Canton, Ohio, and Oklahoma City, Oklahoma

Engineer, of Los Angeles, issued April 16 and August 10, 1921, the following is quoted:

"Our inspection of the existing outfall and the result of analyses of the sewage both show that gasoline and oil reach the Los Angeles sewers to an unusual extent. This is a dangerous situation with respect to the possibilities of explosions putting long stretches of the outfall sewer out of use for a long period."

In *Engineering News-Record* of June 7, 1923 and April 24, 1924, articles by W. T. Knowlton, Engineer of Sewers, city of Los Angeles, describe the plans and construction program of this new sewer.

The length of the North outfall sewer was 15.4 miles, of which a length of 7.2 miles was built of a semi-elliptical design of reinforced concrete with a height of 12 ft. and a width of 13 ft. The remaining portion of the sewer, 8.2 miles, was built with reinforced concrete pipe varying from 4 ft. 9 in. to 8 ft. 6 in. internal diameter.

The interior surface of the sewer above the minimum dry weather flow line was lined with clay plates with cement mortar joints, cast integrally with the monolithic section or pipe.

The question naturally arises as to the condition of the clay plates in the third Los Angeles outfall which, as stated, were constructed with *cement mortar joints*. No

comprehensive inspection has been made, because it is practically impossible to examine the sewer on account of danger of poisonous gases.

On October 10, 1934, as previously stated, I interviewed the officials in charge of maintenance of this sewer and was informed that at the downstream end of the siphon near Culver City there is violent agitation of the sewage and vast quantities of hydrogen sulphide are liberated—oxidized—and as a result, the clay plates have been blown out for a distance of at least 40 ft. I was shown photographs of the interior surface of this sewer at other locations where the sewage is not agitated and consequently the gases are retained in solution. The only evidence of disintegration is the protruding of the mortar joints between the clay plates. The city officials are unable to say to what extent the clay plates are protecting this \$12,000,000 sewer throughout its length, but I was informed without reservation that the city officials of Los Angeles do not consider the use of clay plates as an ultimate solution of the problem. I was informed that chlorination is entirely too expensive, but that certain studies are being made in an effort to control the problem by aeration or common ventilation; and, at the same time, some scheme must be devised to control the odor problem that will naturally result. Needless to add, this is a very perplexing problem and is causing much concern to the engineers of Los Angeles. The following case is of particular interest.

Two rectangular reinforced concrete galleries were constructed in 1923 and convey the sewage from the mouth of the outfall through the screening plant at Hyperion (on the Pacific Ocean). The flow through these galleries was intermittent; while one was in service, the other was empty. To protect the concrete, a *veneer of selected vitrified brick* was constructed, utilizing the minimum amount of cement mortar to seat the brick effectively. My understanding is that the clearance between the brick would average around $\frac{1}{8}$ in. The third outfall was placed in service in 1924, and by 1926 the swelling of the mortar had caused this brick veneer to bulge away from the wall and it eventually fell into the bottom of the galleries. An effort was made to protect the concrete with *special bituminous compounds*, but after a period of several months it was demonstrated that these compounds were worthless for the purpose. To solve the problem, the plant was redesigned so that both galleries would flow full at all times.

Lateral Sewers

Mr. Burtnett's article features the failure of 875 feet of 18-in. *concrete pipe*, known as the Alhambra sewer, and the cost of replacement is listed at \$4,270. He did not refer to the condition of the three outfall sewers mentioned above, for obvious reasons, and was particularly careful to describe failures of concrete pipe that would come within the sizes in which clay pipe is manufactured.

It may be desirable to point out that the sulphate content of the water supply of Los Angeles varies from 200 to 250 parts per million. The high temperature of the sewage in summer months, the impossibility of adequate ventilation because of the serious odor problem caused by free hydrogen sulphide, has made it impossible to ventilate sanitary sewers as is customary in a normally constructed and operated system. The failure of the 1894 brick sewer was discovered as a result of an odor problem. Ventilation was attempted but had to be abandoned be-

cause of complaints of property owners. Moreover, it is well to bear in mind that the distance which sewage is conveyed in Los Angeles is immense—from 50 to 60 miles from the upper reaches of the system to Hyperion, on the Pacific Ocean. The sewage is detained in the lines from 12 to 18 hours and, as previously stated, is of high temperature in the summer months, which has made the hydrogen sulphide problem serious.

Fails to Say It's a Brick Sewer

Mr. Burtnett makes the following statement:

"Another forty-year bond issue was floated down in the rich Imperial Valley of California in 1915 when the cities of El Centro and Imperial installed a \$250,000 sanitary sewer. In 2 years sections of the system had collapsed and were replaced. At this time only \$63,000 of the bonds were paid off, \$187,000 and interest remained. During the next 7 years the history of the sewer was one constant story of repair, replacement and regret. In one 2-year period repairs cost \$16,000. A new bond issue of \$177,000 to replace the system was proposed and indignant taxpayers revolted," etc.

Mr. Burtnett naturally did not emphasize that this sewer was built of *brick construction*, and not concrete. Here are the facts:

El Centro and Imperial, Calif. In 1915-16, an outfall sewer, 27 and 33 in. in diameter, costing \$250,000 and 8.82 miles in length, was constructed to serve the cities of El Centro and Imperial, Calif. Approximately one-half of the sewer is 27-in. *circular brick* laid on a 0.085 per cent grade with a theoretical velocity of 1.9 ft. per second. The theoretical velocity through the 33-in. *brick sewer* laid on a 0.075 per cent grade is 2.1 ft. per second. The collecting system of El Centro is built of clay pipe.

I examined this sewer on October 24, 1925, with P. W. Knights, City Engineer of El Centro. Mr. Knights informed me that a 30-in. unreinforced concrete pipe line approximately 500 ft. in length was *later* constructed to serve as an effluent conduit from the sewage treatment plant and this conduit was eventually extended approximately 300 ft. with 15-in. clay pipe. *The \$250,000 brick sewer* and the 500 ft. of 30-in. concrete pipe were seriously disintegrated above the flow line of the sewage by oxidized hydrogen sulphide.

I was informed by the State Health Department of California in 1925 that the sulphate content of the water supply of El Centro was more than 330 parts per million, and due to the prevailing high temperatures (110 to 115 deg. F. plus), this abnormal condition has developed.

Again Forgetting Four Miles of Clay Block

Again quoting from Mr. Burtnett's article:

"The county of Orange, in California, knows all about the extra costs of 'cheap' sewer pipe. Residents in Santa Ana, Fullerton, Anaheim and Orange had banded together in 1923 to form a sanitation district. In 1925 an alarming state of decomposition of the cement concrete pipe used in the system was disclosed. Approximately \$1,000,000 had been expended and financed under a 40-year bond issue. Yet in 2 years chemical engineers reported that immediate and costly repairs were necessary, and, furthermore, expensive measures must be taken to halt the sewer gas that was the primary cause from literally eating up the cement pipe."

Again he did not mention the *four miles of clay segment block sewer* which is in an advanced stage of disintegration (Figures 1 and 3) far more serious than the concrete pipe sections of the improvement. It was largely for the protection of this lower 42-in. clay segment block sewer and for odor control that the chlorination program was ini-

tiated. The accompanying photograph (Figure 1), which shows what happened within this sewer, was taken by the writer in September, 1927. It is interesting to note, too, the condition of the manhole, which illustrates the swelling of the mortar joints which caused blowing up of the brick masonry. This manhole (Figure 2) is veneered on the exterior surface with portland cement mortar. The large cracks illustrate the extent of the swelling of the mortar.

Cunningham Resolution Turned Down

As pointed out by Mr. Burtnett, on June 6, 1934, Councilman Stephen W. Cunningham, of Los Angeles, intro-



Figure 2. Illustrating the damage to brick masonry caused by swelling of mortar joints. The exterior surface of the brick manhole is plastered with portland cement mortar

duced a resolution in the City Council to exclude concrete pipe from the city specifications for the construction of sanitary sewers "in the sizes in which clay pipe is available." This resolution was referred to the Board of Public Works, and in a special report of July 27 to the Council, the City Engineer said, in part:

"At the end of this fiscal year there has been laid in the city of Los Angeles 742.43 miles of cement pipe without protective lining, and 1,801.09 miles of vitrified clay pipe. These figures do not include house connections. Except for a comparatively small amount in service prior to 1917 the use of this pipe has been the result of competitive bids, either made directly by the manufacturers of cement and vitrified pipe or contractors bidding to furnish both pipe and installation thereof in accordance with resolutions adopted by the City Council on June 22, 1917, and on August 9, 1920, placing the two classes of pipe on an equal basis. . . .

"To summarize, the conditions in the city of Los Angeles are extremely varied with respect to the quantities of sulphide gas or acids from industrial wastes which are to be found in the sewer system, and there are many districts in which cement pipe will last indefinitely. There are other localities which may be reasonably free from injurious gases or acids at the present time, but in which conditions may change, due to increase in population or development of industrial areas. It is, therefore, evident that either cement or vitrified clay pipe will be suitable for many installations, and I recommend that in all cases where both types are suitable and the competition can be

secured, that alternate bids be taken and the authority be vested in your Honorable Board to determine which type of pipe shall be used.

"I further recommend that I be permitted, as in the past, to specify clay pipe for those installations where gas or other forms of waste are, in my judgment, present or likely to be present in sufficient quantities to make such procedure desirable."

At a meeting of the City Council at Los Angeles on



Figure 3. The lower end of the Orange County joint outfall sewer which discharges into the Pacific Ocean through a cast iron subaqueous conduit. Internal hydrostatic pressure due to wave action literally exploded this 42-in. clay segment block sewer, a section of which had to be replaced with reinforced concrete pipe

October 9, 1934, the procedure suggested by the City Engineer was adopted.

Los Angeles Engineers Not Worried

The safest place to use concrete pipe in a sewerage system subject to hydrogen sulphide conditions is in the collecting system, where the smaller-size pipe are required and the sewage is fresh. The grades must be sufficient to provide self-cleansing velocities and the sewage must not be detained in the lines more than 5 hours. This has been the established policy of the Los Angeles Engineering Department since 1917. The action of the City Council in 1917 was based on the performance of concrete pipe sanitary sewers in Los Angeles that were installed in the early eighties and are in service today.

The fight of the clay pipe manufacturers in Los Angeles to exclude concrete pipe from the city specifications in 1917 and today is simply an effort to create a monopolized market and to control the price situation. It is for the same purpose that the *Brick and Clay Record* reprint is being circulated in other cities of the country where similar conditions do not exist—just a smoke screen to create a monopolized market.

Inference that the entire 742 miles of concrete pipe sanitary sewers in Los Angeles will eventually have to be replaced is misleading, and the sensational publicity given the 875 ft. of 18-in concrete pipe costing \$4,270 is not what is worrying the city officials of Los Angeles, nor the taxpayers for that matter. The engineers know that the collecting system is in good condition today, and that trouble has developed or will develop only at points where the sewage is stagnant because of inadequate velocities.

Repair Clay Block Sewers with Gunite

At this point, it may be well to mention a few outstanding cases—Canton, Ohio, for example. In 1915, 7 miles

of 39-in. clay segment block outfall sewers were placed in service. The first indication of trouble there was a severe odor problem, the water supply containing around 100 parts per million of salts of the sulphate class. In the spring of 1933, the city officials of Canton consulted us regarding steps to be taken to preserve the life of this clay sewer by the use of portland cement mortar in the form of gunite. This type of construction was necessary to restore the structural stability, and minimize severe leakage and infiltration.

We informed the city officials that the sewage of the city of Canton should be chlorinated at the upper end of the sewer; otherwise, the mortar (gunite) would not last more than two years.

The Public Works Administration of Washington, in 1934, authorized a loan and grant—No. 378—to the city of Canton for \$40,000 to carry on this reconstruction, but before permitting the city to undertake the work the same authority required the city to install three chlorinators on the line to destroy the bacteria responsible for generating the gas. An additional grant of \$5,000 was allowed for that purpose, and this reconstruction work will be undertaken in the fall and winter of 1934, when the sewage will be by-passed.

St. Louis and Oklahoma City Have Grief

The use of gunite for reconditioning old brick sewers is common practice. In 1926, the city of St. Louis spent more than \$2,000,000 in reconditioning old brick sewers that were in very unsafe condition structurally. As previously mentioned, the life of the second Los Angeles outfall was prolonged by the use of gunite.

Another case of interest is Oklahoma City, Oklahoma. The following official statement as of August 2, 1934, may be of interest:

"In regard to the Packingtown sewer, which has given us so much grief recently, the contract for the construction of the *segmental block portion of this sewer*, extending from a point near Lee and Ash Streets to a point near Fonshill and the C. R. I. & P. Railway right of way, was let June 5, 1917. The contract price on this job was \$197,764.46. I am informed that numerous changes were made during the construction of this sewer because of war conditions and the fact that some of the specified materials could not be obtained. The size of this sewer was changed at various locations.

"As finally built, this line consisted of the following quantities:

8,280 ft. of 48-in.
1,920 ft. of 54-in.
1,350 ft. of 60-in.
6,780 ft. of 72-in.
Total length, 18,330 ft.

"It is laid on a grade of 0.02 per cent. The velocity was calculated at 1.6 ft. per second flowing either full or half full.

"The present condition of this sewer is bad. The liner plates have nearly all fallen off and disintegration has progressed on the joints throughout its entire length. This sewer was the usual result of *segmental block construction* laid in this type of soil, in that there has been an elongation of the horizontal axis and a reduction of the vertical axis. This is caused by the fact that the blocks were not cradled and the loose soil has permitted a deformation from a circular cross section to an elliptical. The H₂S gas as given off by the sewage has, through various chemi-

cal re-actions, attacked the mortar in the joints and caused them to disintegrate. Our tests show that the concrete mortar has been transformed until it is now magnesium sulphate, more commonly called gypsum. This material has a volume several times larger than cement mortar, with the result that the spreading action forces the blocks apart."

Facts About the Sewer Problem

Since 1916, I have personally examined sewers affected by oxidized hydrogen sulphide wherever they have been reported, and I have interviewed the outstanding sanitary engineers of the United States with regard to this problem. In general, it may be said:

(a) The hydrogen sulphide problem is fortunately limited to a few cities of the southwestern United States, and
(b) Only where the water supply is high in salts of the sulphate class and the temperature of the sewage is high (above 70 deg. F.).

(c) Sewers conveying fresh sewage high in sulphates will cause no trouble to concrete or concrete pipe if the pipe lines are built on adequate grades to provide self-cleansing velocities.

(d) Concrete or concrete pipe, regardless of the process by which it is made, will be disintegrated by oxidized hydrogen sulphide (sulphuric acid).

(e) The collecting system where the small pipe (6 to 24 in. in diameter) is used is the safest place to use concrete pipe, because the sewage is fresh and does not become septic until it reaches the interceptors and outfalls usually built of concrete, concrete pipe, brick, clay segment block or concrete sewers "protected" with clay liner plates.

(f) Clay liner plates with cement mortar joints will not protect concrete exposed to severe oxidized hydrogen sulphide conditions.

(g) Sewers built of brick and clay segment block with cement mortar joints are severely disintegrated and destroyed by oxidized hydrogen sulphide.

(h) Bituminous joint compounds between clay plates are practically worthless because they are emulsified by soaps, oils, greases, etc., common in domestic sewage or trade wastes, and for the same reason they are worthless for "protecting" concrete as surface applications.

(i) Sand and sulphur jointing compounds or surface applications are attacked and disintegrated by bacteria at and slightly above the flow line of the sewage.

(j) The *real and perhaps only permanent solution* of

odor control and protecting masonry sewer structures is pre-treatment of the sewage with chlorine to kill the bacteria responsible for generating hydrogen sulphide.

Universal Use of Concrete Proves Values

The Sanitary District of Chicago has, since 1889, expended \$42,000,000 for the construction of concrete sanitary sewers, and the ultimate program will entail an additional expenditure of \$67,669,000 for concrete sewers. The city of St. Louis has completed the River des Peres sewer, built exclusively of concrete, at a cost of \$11,000,000. This sewer intercepts more than 60 city sewers. The sewer varies in diameter from 30 ft. to twin 29-ft. sections. Louisville, Ky., is well along on a \$17,000,000 sewerage program where concrete is used exclusively. Louisville has concrete pipe sanitary sewers in service since 1889. Detroit, from 1920 to 1932, spent \$89,325,000 for sewers, of which \$60,000,000 was for concrete sewers, including lateral sanitary sewers from 12 to 24 in.

The foregoing are mentioned as typical examples to show that the conditions that exist in Los Angeles fortunately do not prevail elsewhere. The 7-mile concrete outfall sewer in Baltimore, placed in service in 1911 and thoroughly examined in 1931, was found to be in excellent condition. The sulphate content of the water supply of Baltimore is only 12 parts per million; and while the sewage travels through this sewer at a very low velocity, no trouble with oxidized hydrogen sulphide could be expected there. The same applies in practically every city of the United States and Canada.

Should Employ Competent Engineers

Concrete is so universally used for the construction of sanitary sewers because of its permanence, structural strength, and maximum hydraulic capacity, and because it minimizes leakage and infiltration.

I believe that practically all of these hydrogen sulphide problems can be avoided if city officials will employ competent sanitary engineers who are also chemists and bacteriologists to review the plans and specifications for new improvements. It has been customary in too many cases to employ such experts *after* trouble develops. In general, we have had no trouble with concrete sewers where they were properly designed and constructed, following the elementary principles of hydraulics and sanitary engineering.

Winter Concreting

(Continued from page 5)

cure—in winter as well as summer. If heat is supplied by wet steam, sufficient curing moisture is usually available. If dry heat is used (salamanders, etc.), be careful to avoid drying out. Dried-out concrete will not gain in strength as it should. If air is dry, water should be applied to the concrete.

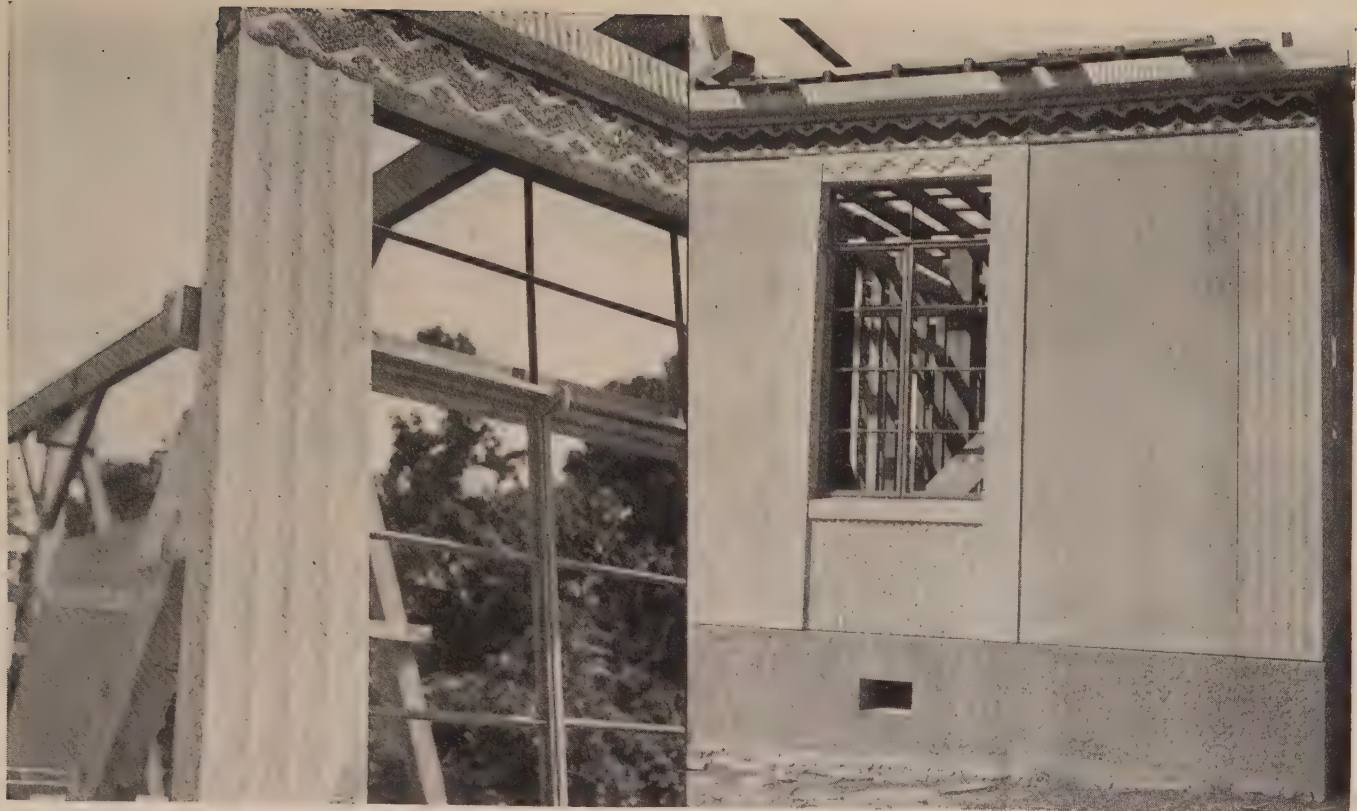
9. *Don't Take Chances:* It pays to be on the safe side; don't take chances simply because you may know of successful concreting in cold weather without proper protection. It is true that frozen concrete has hardened after thawing; but that is sheer good luck—not good management.

When high-early-strength cement is used, the additional expenses necessary to make certain that cold weather does not affect the strength of the concrete is so small that it doesn't pay to neglect the simple precautionary measures.

NOTE. *Test specimens, due to their small mass, invariably give strengths in cold weather lower than that of concrete in the structure. Great care must be exercised to cure the specimens at temperatures comparable to those in the structure itself.*

Early-Strength Cement Reduces Heating Period

For the foregoing "essentials," CONCRETE is indebted to the International Cement Corporation. This company's well-illustrated publication entitled *Winter Construction with "Incor" 24-Hour Cement* treats the subject of cold-weather concreting from the practical standpoint of the contractor. The advantages of high-early-strength cement in placing concrete during cold weather are, of course, well known to the construction industry. Outstanding among these advantages are the shorter time during which the concrete must be kept warm, and the fact that the heat of hardening is generated at a rate sufficiently rapid to be of material aid in keeping the proper temperature.



Close-up view of window panel (left) and of exterior wall surface (right)

Courtesy The American Builder

Low-Cost House of Pre-fabricated Concrete Panels

John J. Earley Turns Attention to Small-House Architecture and Construction—Many Architects Visit Building

ARCHITECTS, builders and engineers from New York, Chicago, Philadelphia and Washington were among visitors who, early in November, inspected the small pre-fabricated architectural concrete house being built as an experiment by John J. Earley, noted architectural sculptor. The house is located on the Colesville pike opposite the Indian Spring golf course, near Washington, just across the Maryland state line. Colesville pike is the extension of Sixteenth Street, Washington.

Assembly of Precast Panels

The development and construction of this pre-fabricated concrete house was explained by Mr. Earley to a gathering of architects, as reported by the *Washington Star*. The house, he explained, represents the result of 15 years of research and experiment; and while it utilizes the methods that have been developed in connection with larger buildings, this is the first instance in which these methods have been applied to small-house construction.

The house is essentially an assembly of precast wall panels, supported temporarily on a wooden framework

until the cast-in-place reinforced concrete pilasters take up the burden as supporting members.

How Precast Panels Are Made

The precast reinforced concrete wall panels are 9 ft. high, with widths varying up to 10 ft., and their thickness is 2 in. They are completely precast—and this includes the sculptured cornice and a decorative frieze.

To make these panels, the method followed was essentially the same as that employed in casting the decorative ceilings in the Department of Justice Building, described on page 20 of the November issue of *CONCRETE*. Plaster molds were first made, and a mixture of properly colored stone and sand was prepared and combined with white cement and water. This produced a plastic concrete that was easily put into place on the lower surface of the mold, to serve as the exterior face of the panel in the finished wall. This facing coat was then covered with reinforcing wires and the remaining depth of the mold was filled with a mixture of ordinary concrete, proportioned so as to obtain the highest possible degree of density.

Finishing and Curing

The cast was then allowed to harden for 12 hours, when it was removed from the mold and the surface was wire-brushed to remove the surface film of cement from the exposed faces of the colored aggregate. The surface was then given a bath of weak hydrochloric acid to bring out the full brilliance of the colors in the aggregate. The

as two sides of the form work for the reinforced concrete pilasters that were concreted in place. After the pilasters had hardened they constituted the supporting columns of the wall, and the wooden studs were utilized as nailing blocks for the inside wall finish. The remaining wall space was filled with mineral wool.

Expect Cost to Be Low

The high standing of Mr. Earley in the field of architectural concrete lends unusual interest to this experimental project. From the standpoint of cost, it is his belief that through the use of this method it will be possible to build beauty and permanence into the walls of the low-cost house, even in houses of the subsistence homestead type. Cost figures will be made known at a later date.

Highway Research Board Annual

List of Topics to Be Discussed—Cover All Phases of Highway Engineering

The Fourteenth annual meeting of the Highway Research Board will be held in Washington, D. C., at the building of the National Academy of Sciences and National Research Council on Thursday and Friday, December 6 and 7, 1934. Following is the list of topics to be discussed:

HIGHWAY TRANSPORTATION ECONOMICS

Road Widths and Accidents
Vehicle Operating Cost
Gasoline Consumption
Pavement Mortality Records
Relation of Vehicle Weights to Design of Roads
Road Costs

TRACTIVE RESISTANCE

Skidding on Curves and Further Data on Coefficients of Friction

HIGHWAY DESIGN

Design of Brick, Tar, Asphalt and Concrete Surfaces to Obviate Slipperiness
Roadside Development
Durability Tests of Cold Bituminous Mixes

LOW COST ROADS

A Symposium on Research Features of Flexible Type Bituminous Roads and the Application of Soil Science in Their Design and Construction.

MATERIALS AND CONSTRUCTION

Use of High Elastic Limit Steel as Concrete Reinforcement
Effects of Calcium Chloride on Concrete
Construction of Fills in Peat Bogs
Relation of Cement Composition to Durability of Concrete

MAINTENANCE

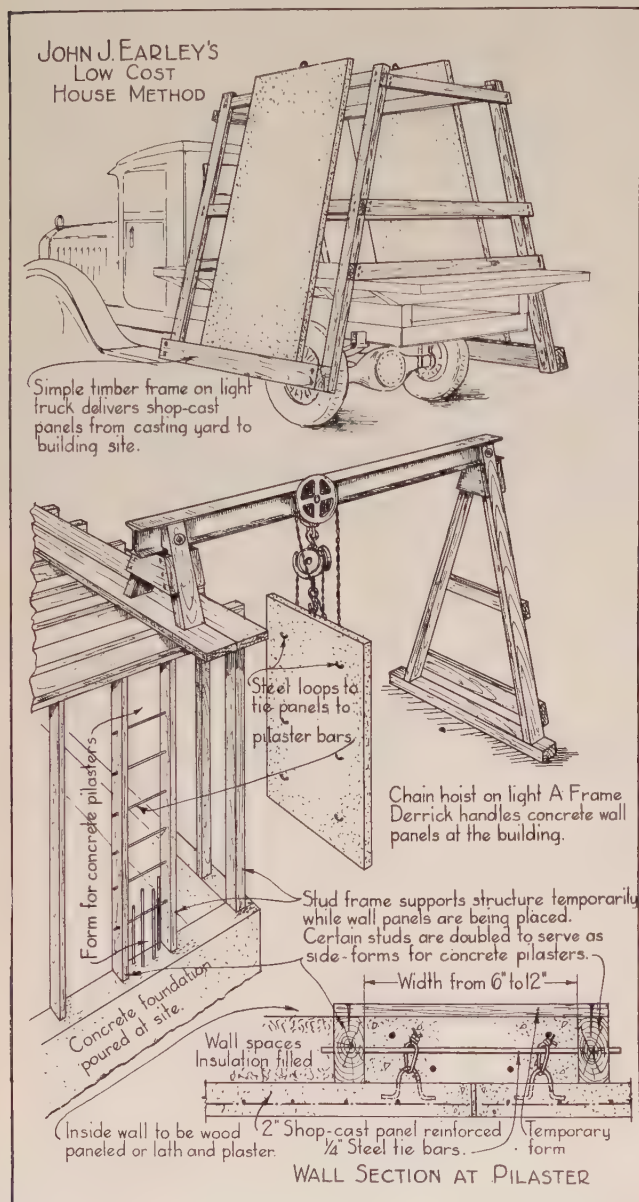
Warping of Concrete Pavement Slabs

TRAFFIC

Psychological Tests of Drivers
Relation of Light to Highway Accidents
Toll Bridge Traffic Data
Safety Zones
Traffic Regulations in Municipalities
Studies of Highway Capacity

Correction

IN the November issue of CONCRETE, in the article headed "Concrete Imitates Rock Formations in Dens for Wild Animals," Edwin H. Clark, the designer, is erroneously referred to as a landscape architect. Mr. Clark, though familiar with landscape architecture, is engaged in the general practice of architecture.



Courtesy The American Builder

Transportation and erection of precast wall panels, and detail of finished wall construction

slabs were then moist-cured in curing chambers for 14 days.

Transporting and Erecting the Panels

To transport the precast wall slabs to the building site, a light truck was used, fitted with inclined carrying racks as shown in the line illustration. On the job site the panels were lifted into position by means of the equipment shown and were set against, and secured to, a previously-built wooden framework. At all vertical joints between slabs two wooden studs set from 6 to 12 in. apart had been built into the framework, and these studs served

BOOKS On Concrete

List No. 2—Design and Construction, Concrete Making, Cement Manufacture

(Prices quoted are for cash in advance, and include postage)

DESIGN AND CONSTRUCTION OF FORM WORK FOR CONCRETE STRUCTURES. By A. E. Wynn. 320 pages, 219 ills., 12 folded inserts and 11 design tables. Cloth bound, stamped title in gold. Price \$8.00

"Wynn's Book" is a phrase commonly known to engineers, designers, and foremen, and is heard wherever concrete construction is under way. This book covers every phase of forms for concrete construction, and is fully supplemented with many illustrations, tables and drawings and printed on a superior grade of enameled paper.

CONCRETE CONSTRUCTION MADE EASY. By Leslie Turner and Albert Lakeman. 113 pages, 65 illustrations, 16 tables. Cloth bound. Price \$2.00

A practical book that solves problems in the design and erection of any type of concrete structure. Full designs with tables and all necessary information for building of foundations, walls, columns, floors, roofs, staircases, beams, water tanks, retaining walls, lintels, formwork, saw-tooth roofs, etc. Written clearly and plainly.

BASIC PRINCIPLES OF CONCRETE MAKING. By Franklin R. McMillan, Director of Research, Portland Cement Association. Ninety-nine pages, 6x9½, 32 illustrations and tables. Price \$2.00

The author has culled the essentials out of a mass of scientific data on this subject and presents them with force and directness in this book. He shows the effects of quality of material, of proportioning, mixing, working and curing on the finished concrete.

The importance of variable mixes; tests for permeability; how to obtain strength, durability and watertightness; effective ratios; importance of proper construction methods—these and many other vital topics are discussed fully and authoritatively.

GENERAL ENGINEERING HANDBOOK. By Charles Edward O'Rourke and 29 associates. Flexible cover; 921 pages, 5 by 8 in., numerous tables, diagrams, and illustrations. Price \$4.00

A great amount of fundamental engineering data in usable form, 31 separate sections dealing with as many specific branches of engineering. Of particular interest to engineers who specialize in the use of concrete as a structural material are sections devoted to "Highways," by Thomas R. Agg; "Reinforced Concrete Structures," and "Stresses in Framed Structures," by Charles Edward O'Rourke; "Engineering Materials," by Herbert H. Scofield; "Foundations," by Roland P. Davis; and "Mechanics," by Alfred P. Poorman.

REINFORCED CONCRETE CONSTRUCTION. By George A. Hool, Professor of Structural Engineering, University of Wisconsin.

Vol. I—Fundamental Principles. Third Edition. 380 pages, 6x9, 139 illustrations, 18 tables, 28 diagrams\$3.50

Vol. II—Retaining Walls and Buildings. Second Edition. 700 pages, 6x9, illustrated.....\$6.00

Vol. III—Bridges and Culverts. 688 pages, 6x9, over 600 illustrations, 41 plates.....\$6.00

ESTIMATING AND COST KEEPING FOR CONCRETE STRUCTURES. By A. E. Wynn. Published in 1930; 272 pages, 92 illustrations, 2 folders. Price \$5.00

The author of this book has had a wide experience in contracting for all kinds of concrete structures, and in this volume he publishes his own simple methods of estimating, cost-keeping and book-keeping. Reproductions are given of all blank forms required.

CONCRETE ENGINEERS' HANDBOOK. By George A. Hool and Nathan C. Johnson, assisted by S. C. Hollister, and with chapters by Harvey Whipple, Adelbert P. Mills, Walter S. Edge, A. G. Hillberg and Leslie H. Allen. 800 pages, 6 x 9. Illus. Flexible binding. Price \$6.00

A compact reference book, containing tables, formulae and data on plain and reinforced concrete, covering the entire field.

CEMENT CHEMISTRY IN THEORY AND PRACTICE. By Prof. Dr. Hans Kuhl, Director of the Institute for Cement Research, Berlin. Translated into English by J. W. Christelow, B.Sc. 64 pages, 6 by 9, cloth cover. Illustrated with a number of halftones and diagrams. Price \$2.50

An authoritative book on the chemistry of cement, a translation of a series of lectures delivered by Dr. Kuhl in Moscow, at the special request of the Soviet government. The author presents the most up-to-date knowledge of the subject in simple language. The result is a concise record of modern research on the manufacture and setting of cement. Chapter headings are: (1.) The Development of Cement Research; (2.) The Theory of Cement Burning; (3.) The Constitution of Portland Cement Clinker; (4.) The Problem of Hardening and Its Significance in Cement Research; (5) The Chemistry of High-Strength Cements; and (6.) The Technical Aspect of High-Strength Cements.

PORTLAND CEMENT. By A. C. Davis, works managing director, Associated Portland Cement Manufacturers, Ltd. Published in 1934. Cloth, 435 pages, 6½ by 9½ in., 262 illustrations, 22 tables. Price \$8.00

A new book on cement manufacture, covering more especially the present-day British and continental practices. The author discusses and analyzes such important problems as modern manufacturing methods and organization; formation and nature of cement raw materials; factors governing choice of materials and manufacturing processes; advantages of dry and wet processes; raw material and clinker-grinding problems; improving the efficiency of the rotary kiln; methods of coal feed, slurry drying, and kiln control; reactions in burning cement; rotary kiln heat balances; conservation of heat in rotary kilns; advantages of the purchase of electricity compared with generation at the factory; modern methods of packing and shipping cement; production costs; mineralogy and chemistry of cement.

STANDARD CONSTRUCTION METHODS. By G. Underwood. 408 pages, 330 illustrations. Price \$5.00

A complete, detailed presentation of actual methods used in practical construction work. A book packed from cover to cover with plans, short-cuts and expedients for construction superintendents and other men upon whom rests the responsibility of getting jobs done quickly and well.

REINFORCED CONCRETE AND MASONRY STRUCTURES. By Hool and Kinne. 722 pages, 6 x 9, illustrated. Price \$6.00

The work of 14 specialists. This book offers a practical and detailed discussion of every important element entering into the design and construction of concrete and masonry structures. Particularly noteworthy are the very thorough treatments of Reinforced Concrete Buildings, Concrete Forms, Chimneys and Concrete Detailing.

HELPS TO SUCCESSFUL CONTRACTING. By Harry O. Locher. Published in 1934; 222 pages, 5½ by 8 in. Price \$2.00

An unusual book for contractors, covering every phase of the work from estimating and bidding to cleaning up and moving to the next job. Written by an author with more than 30 years of experience in the contracting business. Every contractor and construction superintendent or foreman should have a copy.

WINTER CONSTRUCTION METHODS. By Charles S. Hill. Cloth, 180 pages, 6 by 9 in., illustrated. Price \$3.00

This book assembles in one volume the practices found most effective in carrying on concrete construction work in cold weather. Subjects treated in individual chapters include construction of concrete bridges, roads and street pavements in winter; use of special cements in cold weather; heating of materials; handling and placing concrete; protecting concrete in heavy sections; progressive canvas housing for building construction; and use of complete enclosures.

SPECIAL COMBINATION OFFER: \$1.50 (or \$2.00 for Cement Mill Edition) added to the price of any of the above listed books will entitle you to one years subscription to Concrete or extend your present subscription one year from its present expiration date. Foreign and Canadian subscribers please write for details.

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◀ *A department devoted to the solution of problems encountered in concrete work. Readers are welcome to add to or improve upon the suggestions printed and to submit their views for possible publication.* ▶

Concrete Brick Must Be Cured

Please give me the names and addresses of manufacturers of machinery that has proved successful in the production of concrete brick. May I also have your opinion concerning the source of trouble with concrete brick? For some reason, there is a certain amount of prejudice against concrete brick in this section.—J. P. B., Utica, N. Y.

The question you raise as to the prejudice against concrete brick can be answered by the statement that this prejudice arises from two sources. The first source, as you may well surmise, is the intensive propaganda broadcast by the clay-brick interests, who have given the widest possible publicity to every case where troubles developed with concrete brick, no matter how trivial the trouble may have been. This character of propaganda is now well understood by the public and need not be discussed further.

The second source of prejudice has its origin in the failure to allow sufficient time for the shrinkage of concrete before the brick were placed in the wall. This was the case with some school buildings in Baltimore. No concrete units, whether brick, block or tile, should be placed in masonry walls until the concrete has had sufficient time to take its initial shrinkage. Under ordinary curing conditions and ordinary temperature conditions, about 30 days will be required for this normal shrinkage to take place. Where high-pressure steam curing facilities are utilized at the manufacturing plant, this initial shrinkage can be obtained in about 48 hours. In consequence, units cured under high-pressure steam may be used in a wall very soon after their manufacture. Units cured under ordinary conditions should not be laid up until 30 days or more after their manufacture.

A list of manufacturers of concrete brick-making machinery is being forwarded.

Grinding Slag with Cement Clinker

What is the supposed advantage in grinding slag with portland cement clinker, a practice that seems to be quite general in Europe, more especially in Germany?—G. R. J., Los Angeles, Calif.

It is true, as you say, that the practice of grinding blast-furnace slag with portland cement clinker is quite general in Germany, where slag-portland and iron-portland cements have been in use for many years. The German slag-portland cements are made by grinding to cement-fineness a mixture of 30 per cent of portland cement clinker and 70 per cent of granulated blast-furnace slag. The German iron portland cements are similarly made, except that the proportions are 70 per cent of cement clinker and 30 per cent of granulated slag. In England a British standard specification for "portland blast-furnace cement" permits an addition to portland cement clinker of not more than 65 per cent of granulated blast-furnace slag, the mixture being ground to cement-fineness.

The purpose of grinding granulated blast-furnace slag with portland cement clinker is that of producing a cement which in turn will produce concrete that will be more highly resistant to the attack of aggressive waters such as sea water and alkali water. During the hardening period of concrete, when ordinary portland cement is used, a certain amount of calcium hydroxide is liberated. This hydroxide is soluble in water. But when granulated slag has been ground with the cement clinker, as with the German slag-portlands, it is said that the silicate in the slag unites with the calcium hydroxide almost as soon as the latter is liberated, forming an insoluble lime silicate which is not acted upon by ordinary water or by water containing dissolved sulfates.

It must not be supposed, however, that all kinds of siliceous materials are suitable for use in the production of cements of this type, even though the chemical analysis of the material under consideration may indicate that it should be suitable. Chemical analysis alone is not a proof of suitability. The question is whether the siliceous material to be used, after being finely ground, is chemically active to a sufficiently high degree to enable it to convert all the calcium hydroxide liberated during the hardening process into the insoluble lime silicate previously mentioned.

Care must also be taken not to confuse slag-portland cements with slag-lime cements. The latter type contains no portland cement, but is produced from mixtures of granulated blast-furnace slag and hydrated lime, ground together to cement-fineness.

Calcium Chloride in Winter

Can you refer me to literature on the use of calcium chloride in concrete placed during cold weather?—M. R. C., Portsmouth, Va.

This subject is treated quite thoroughly in a 5-page article entitled "Use of Calcium Chloride as a Protection Against Freezing of Concrete," published in the April (1923) issue of CONCRETE, beginning on page 150. The authors of the article are Paul Cottringer and Harold S. Kendall, of the Dow Chemical Company.

For additional information you should write to the Calcium Chloride Association, 4200 Penobscot Building, Detroit, Mich.

Mechanical Floating Machine

On page 15 of your issue of October, 1934, in the article headed "Placing Colored Concrete Topping," reference is made to an approved mechanical floating machine. Can you refer us to American equipment manufacturers who supply such devices?—S. C. G., London, England.

The names and addresses of several American concerns who make this equipment are being forwarded to you.

New Books and Pamphlets

Everyday Chemistry

PRACTICAL EVERYDAY CHEMISTRY. By H. Bennett, Editor-in-chief of The Chemical Formulary. Published by the Chemical Publishing Co., New York. Cloth, 305 pages, 5½ by 8½ in. Price \$2.00.

This book contains hundreds of practical formulas, accompanied by the necessary explanatory text for the application of chemistry to the making of products of everyday use. One chapter, devoted to materials of construction, gives formulas and proportions for materials and products such as concrete itself, and for mortars, plasters, stuccos, colored concrete, acid-resistant treatments, dustproofing preparations, remover of efflorescence, waterproofing coatings and liquids, acid washes for cleaning concrete, cement accelerators, concrete floor hardeners, and related materials.

Urge Major Construction Program

THE POT, by Charles Sullivan Broward, Miami, Florida. Published by the author.

This brochure has been written with the aim of agitating a nation-wide, popular demand for a major public works construction program, through the regular channels of private contractors, as a requisite to re-employment and recovery. The author makes out a strong case in favor of such a program.

Copies of the booklet have been supplied to every member of Congress. It is suggested that individuals and industries related to construction can aid in popularizing this movement by distributing copies of the booklet to their friends and acquaintances occupying influential positions.

Cement-Bound Macadam Manual

CEMENT-BOUND MACADAM. Published by the Portland Cement Association, 33 W. Grand Ave., Chicago, Ill. Paper cover, 24 pages, 7½ by 10 in., illustrated.

This booklet is virtually a manual of design and construction practice for cement-bound macadam roads and pavements. Subjects covered include (1) design recommendations, (2) estimating quantities of materials, (3) construction procedure, including steps in construction, and (4) turning old brick pavements into cement-bound macadam. There is also a complete "Specification for Cement-Bound Macadam Pavement."

Calcium Chloride and Cement

THE REACTION OF CALCIUM CHLORIDE ON PORTLAND CEMENT (Progress Report), by Paul Rapp and Lansing S. Wells. Reprinted from the *Proceedings* of the Thirtieth Annual Meeting of the Highway Research Board. Copies may be obtained on request, from the Calcium Chloride Association, 4200 Penobscot Bldg., Detroit.

Inspected Concrete Block and Tile

LIST OF INSPECTED FIRE PROTECTION APPLIANCES, dated July, 1934, a 125-page paper-covered bulletin published by the Underwriters' Laboratories, 207 East Ohio St., Chicago, contains lists of manufacturers of hollow concrete block and hollow concrete tile whose products are approved under the inspection service of the Underwriters' Laboratories. Specification requirements also are included.

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(Continued from page 12)

Marked Effect of Calcium Chloride and High-Early-Strength Cement

The use of high-early-strength cement is of considerable value in overcoming the effect of low temperatures, due to its rapid state of hydration, and its use in place of standard portland cement and calcium chloride is a matter of economic consideration. The use of high-early-strength cement together with calcium chloride produces very marked results in the early strength of concrete even when it is placed at very low temperatures and without special protection.

When temperatures at the time of placing concrete are near freezing and remain low the use of either high-early-strength cement or calcium chloride, or both, must not be entirely relied upon to insure proper setting of the concrete. Temporary enclosures, heated with salamanders, or the covering of pavements, sidewalks, etc., with at least a 6-in. layer of straw uniformly distributed and held in place by canvas or burlap, must be provided.

In Very Cold Weather

Heating of the mixing water is effective in raising the temperature of the concrete, as is also the heating of the aggregates. Whenever freezing temperatures prevail, the aggregates themselves are likely to be frozen and must be heated to insure against the incorporation of lumps of frozen material in the mix. A further application of heat than is necessary to thaw out or prevent these materials from freezing will be of very definite value in increasing the temperature of the aggregates, and, therefore, that of the concrete.

Tests on specimens of concrete made at the construction site and cured under conditions as nearly as possible the same as the concrete in place, offer a definite means of checking the quality of the concrete. The small specimens will be more affected by the temperature changes than the larger mass, and therefore if a satisfactory rate of hydration is indicated by the results of tests on these small specimens, this fact provides assurance that satisfactory curing of the construction concrete is taking place.

Specifications for Use of Calcium Chloride

Following are the specifications for cold-weather protection of concrete as issued by the Highway Department of the District of Columbia:

"Whenever the temperature may be expected to reach 50 deg. F., or lower, during the 24 hours following the placing of the concrete, calcium chloride incorporated in the concrete mix shall be used for curing of the concrete, in lieu of whatever method of curing is being used.

"Whenever the temperature may reach 32 deg. F., or lower, during the 24 hours following the placing of the concrete, the surface of the pavement shall be covered with hay, straw, or other material approved and as directed by the engineer, for at least three days.

"Heating of aggregates may be required during prolonged periods of freezing temperature, or lower.

"Preparation and use of calcium chloride shall be as follows: Place one bag (100 lb.) of calcium chloride in a barrel and add sufficient water to make a solution of 25 gallons (one-half barrel). This solution should be

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stirred to be sure the calcium chloride is completely dissolved.

"An amount (1½ to 2 quarts) as directed by the engineer shall be added to the concrete mix for each bag of cement. The quantity of mixing water shall be reduced by the amount of calcium chloride solution used. The method of incorporating the solution into the concrete mix shall be approved by the engineer."

Recommended Practice

The following recommendations for obtaining high-early-strength concrete at all temperatures may be assumed from the laboratory and field studies discussed. The use of standard portland cement with the basic amount or high-early-strength cement depends upon the prevailing cost of the materials.

(1) Standard portland cement and calcium chloride obtain high-early-strength concrete for temperature conditions of 70 deg. F., and above.

(2) The basic unit cement content with additional standard portland cement and calcium chloride or high-early-strength cement should be used to obtain high-early-strength concrete for temperature conditions between freezing and 70 deg. F. (The durability benefit to be derived from increasing the basic unit cement content should also be considered.)

(3) For temperature conditions below freezing either standard portland cement with an increased basic cement content, or high-early-strength cement, may be used; but proper protection should be provided and calcium chloride should be incorporated in the concrete mix.

(4) It is important to place concrete on a rising temperature, in order to increase the early strength of concrete (unless special provisions are provided for maintaining the temperature of the concrete). During low temperatures concrete should be placed in the morning and permitted to have the afternoon, when the temperature is rising, rather than to be placed in the afternoon during the highest temperature, and subjected to the lowering temperature immediately following its placing.

If rational consideration is given to the properties of concrete, the construction season can be lengthened to a major degree with utmost confidence as to the results to be obtained. This lengthening of our working season is a worth-while economical as well as industrial factor.

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FOLLOWING shortly after the Modern Home Exposition to be held in St. Louis in January, a similar 9-day exposition will be held at the Coliseum in Chicago from February 16 to 24, inclusive.

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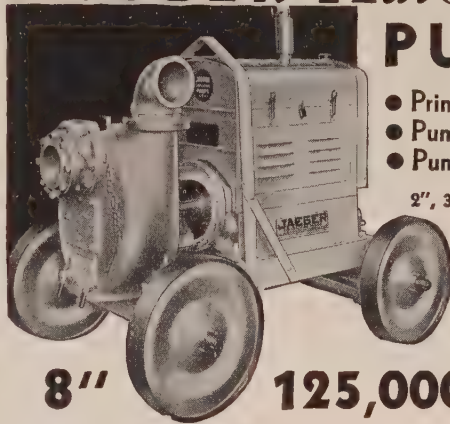
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EQUIPMENT AND MATERIALS

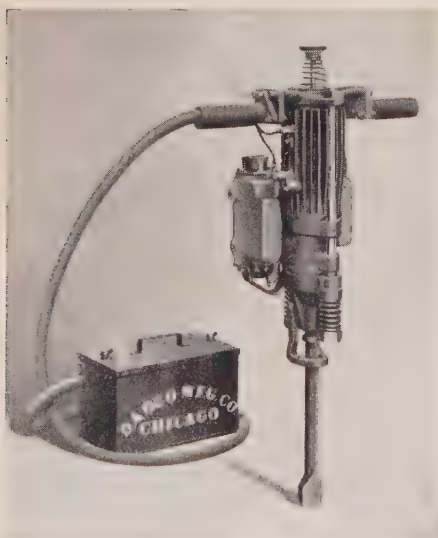
SNAP-TYS for concrete wall construction, a new product, is illustrated on a leaflet with nine views of the operation from the erection of the forms to the pointing of the small rod hole at the finish.



Forms ready for the concrete

These form ties are complete with Spreader-Ty-Gauge—all in one—and are said by the makers, the Richmond Screw Anchor Co., Inc., Brooklyn, N. Y., to be time, lumber and material savers.

BARCO portable gasoline hammer is a new tool for breaking concrete and general demolition purposes, made by the Barco Manufacturing Company, Chicago. The largest size Barco hammer weighs but

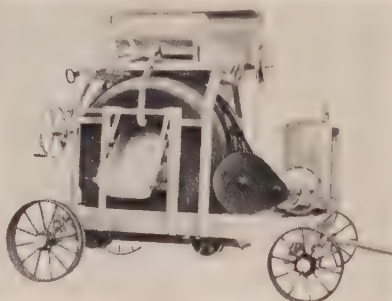


The Barco gasoline hammer

89 pounds, the makers say and tests as well as actual performance have shown that it offers all the advantages of quick transportation and adaptability to any kind of job at low operating cost without any sacrifice of power.

KNICKERBOCKER mixers, of which the 7-S and 10-S sizes were announced last month, embody design features likely to appeal to both engineers and contractors because they are said to assure unusually thorough mixing combined with rapid handling of dry materials and mixed concrete.

The drum is of large diameter and the distance from opening to opening comparatively short. This shape keeps the aggregates together and permits larger openings for charging and discharging. The manufacturers, the Knickerbocker Co., of Jackson, Michigan, point out that the 60 deg. loading skip is the steepest ever offered and is made possible by the largest charging opening ever designed for



The new Knickerbocker mixer

similar sized power loading mixers. This combination facilitates rapid charging. Skip pounding and shaking are eliminated.

Once in the drum, the materials are subjected to the traditional Knickerbocker re-mixing action, which has been improved and refined. The materials are cut and folded by blades and carried by buckets to the top of the drum, whence they spill onto the discharge chute which, in mixing position, acts as a deflector, returning the mass to the charging side of the drum, where the folding and kneading action is repeated. The wide discharge chute, in discharge position, assumes a 48 deg. angle which results in emptying the drum almost instantly.

The complete operating cycle—charge, mix and discharge—makes possible a batch schedule profitably timed from the contractor's standpoint. The unusual speed of the first and third phases allows ample time for the mixing period, to satisfy the most rigid engineering requirements.

The low center of gravity on these machines makes for stability. Concealed and protected coil springs in the truck frame, with three-point suspension, absorb road shocks.

WOOD'S new Closed-Back hand shovel is said in many ways to resemble the familiar hollow-back type except that instead of the usual hollow in the back of the blade there is a steel plate welded securely to the blade and extending into the socket. In this construction, the one-piece steel blade is made smooth both front and back, and yet permits the use of the tapered socket which is heat-treated to provide greater strength and springiness than is usually found in the heavy solid shank. With this type of socket, the lift or bend usually found only in plain back shovels is applied to this new model. Thus, this Closed-Back model, made by The Wood Shovel and Tool Co. of Piqua, Ohio, is said to incorporate the advantages of other types without any of the disadvantages.

QUARTZOID is a new kind of cast stone, with a highly glazed surface, said to be durable, waterproof and stainproof. The Quartzoid Products Co., St. Louis, is owner of the process and method of manufacture.

I-BEAM-LOK armored construction—a recent development—is a combination steel and concrete slab, described in a 24-page booklet published by the Carnegie Steel Company of Pittsburgh, Pa.

Industrial Literature

BURIAL Vault Molds and Vault Makers' Supplies is the title of a complete new catalog just published by the Automatic Sealing Vault Co., Peru, Indiana.

Subjects treated include a discussion of concrete as a material for burial vaults, use of adjustable molds, manufacturing operations, sizes of vaults, recommended retail prices, and cost of manufacture. Needed accessories, including a geared hoist of one-ton capacity, are described and illustrated.

Prospective manufacturers of vaults should write for a free copy of this well-prepared catalog.

REX concrete mixers are illustrated and described in a recent mailing piece compiled by the Chain Belt Company of Milwaukee. The folder explains the outstanding features and how the makers have incorporated in the Rex line of mixers all the principles which make for an assured quality concrete and a modern high speed production.

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The Cement Mill Edition of *Concrete*

The Cement Mill Edition of *CONCRETE* is edited exclusively for those interested in the manufacture of portland cement and related products.

Its pages are devoted to discussions of plant design, management, operation, production efficiency, chemical research and control, quarry operation, progress and news of the industry.

The Cement Mill Edition also contains all the material published in the corresponding Regular Edition and so provides news of the uses and merchandising of the materials whose manufacture is discussed in the Mill Edition.

The Regular Section furnishes mill operating officials and mill executives valuable points of contact with the users of the materials they produce.

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CEMENT MILL SECTION of

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J. C. WITT, *Consulting Editor*



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The Chemistry and Manufacture of Gypsum-Anhydrite Cement

Various Raw Materials Employed—Steps in Production—
 Physical Properties and Constructional Uses of Cement—
 Suitable Natural Deposits in United States

By PETER P. BUDNIKOFF

Professor, Laboratory of Ceramics, Chemistry Technological Institute, Charkoff, U.S.S.R.

Other articles on the chemistry and manufacture of special cements, by this author, will be found in the Cement Mill Edition of CONCRETE, in the issues of March, 1934, page 39, and June, 1934, page 35.—EDITOR.

GYPSUM-ANHYDRITE cement is obtained by burning natural gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) at 500 to 700 deg. C., and subsequent grinding of the burned material with various additions; or by grinding natural anhydrite (without burning) with suitable additions.

Some Raw Materials

If natural bihydrous gypsum rock ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) is taken to produce gypsum-anhydrite cement, it is burned between 500 and 700 deg. C. The fuel requirements for the burning process can be computed from the reaction—
 $\text{CaSO}_4 \cdot 2\text{H}_2\text{O} \rightarrow \text{CaSO}_4 + 2\text{H}_2\text{O} - 435 \text{ cal.}$

Practically, the fuel required for converting gypsum into an insoluble anhydrite is approximately 9 to 10 per cent of the weight of the finished product.

Initial raw materials for the production of anhydrite cement are natural gypsum rock, natural anhydrite, dolomite or magnesite, sodium bisulfate or sodium sulfate, copper sulfate, and basic blast-furnace slags.

Technology of Production

The technology of the production is based on the following formulas:

A. Anhydrite Cement for Building Purposes:

Gypsum, burned at 500 to 700 deg. C., or unburned natural anhydrite.....98 to 99 per cent.
 Sodium sulfate or bisulfate.....1.5 to 1.0 per cent.

B. Anhydrite—Dolomite and Anhydrite—Slag Cement—for Building Purposes:

(1) Gypsum burned at 500 to 700 deg. C.....95 to 97 per cent
 Dolomite or magnesite, burned at 500 to 700 deg. C.....5 to 3 per cent
 (2) Gypsum, burned at 500 to 700 deg. C., or natural unburned anhydrite.....85 per cent.
 Basic granulated blast-furnace slag.....15 per cent.

C. Anhydrite Cement for Finishing Work:

Gypsum, burned at 600 to 700 deg. C.....98.5 per cent.
 Sodium bisulfate.....0.8 per cent.
 Copper sulfate.....0.7 per cent.

The scheme of production involves the following steps, in the order given:

Crushing—Particles measuring about 10 cm.

Burning—At 500 to 700 deg. C., in a shaft kiln.

Crushing—In rollers.

Grinding—Simplex or disintegrator, with separators, or a tube mill.

Packing—Loading in bulk, or in sacks, or in barrels

Reducing Atmosphere Avoided

When burning, a reducing atmosphere must be avoided because the influence of CO and carbon make possible the formation of calcium sulfide, which can lead to inconstancy of volume in the presence of NaHSO_4 and other sulfates of alkaline and heavy metals.

When burning gypsum to anhydrite, if sodium sulfate is added as a catalyzer care must be taken to avoid over-burning. The temperature must not be raised above 750 deg. C. The formation of free calcium hydroxide lowers the mechanical strength of anhydrite cement in the presence of NaHSO_4 or Na_2SO_4 .

The gypsum must remain in the zone of highest temperature (600 to 700 deg. C.) for a period of 30 minutes, if complete burning over the entire cross-section of the shaft is to be obtained.

The burned dolomite or magnesite necessary for addition can be burned periodically in the same kilns as the gypsum.

Quick Cooling of Clinker Necessary

The burned material is transferred to a conveyor, by means of which it is transported to the storage shed where it cools for a period of 4 to 5 hours. The storage shed must be built in a way that will protect the anhydrite or burned dolomite from atmospheric influences, and at the same time permit the entrance of a maximum quantity of air for quick cooling.

From the storage shed the anhydrite is transferred to

a hammer or roller mill. The crushed material is then transferred by a bucket elevator to a bunker, and from there through a feeding device to a mill (simplex or disintegrator, with a separator, or to a ball mill provided with a hopper). In the ball mill finer screens than those used in ordinary ball mills for grinding cement clinker are admissible. The fineness of grinding corresponds to 20 to 22 per cent residue retained on a screen of 4,900 per sq. cm. (178 meshes per lin. in.).

Introduction of Catalyzers

The catalyzers (sodium bisulfate or sodium sulfate and copper sulfate, etc.) must first be mixed together in the proportions needed, with an addition of 10 to 20 per cent of anhydrite, and then ground. This ground mixture is then transferred to a special bunker placed at the side of the bunker containing the anhydrite, from where it is fed to the mill at the same time as the anhydrite, with the aid of a small feeding worm with a friction drive, which fulfills at the same time the function of a bunker lock. The friction drive is arranged in a manner similar to that of the device for feeding pulverized coal to a rotary cement kiln.

Burned dolomite, after being crushed to particle sizes of 20 to 30 mm. (roughly 3/4 to 1 1/4 in.), is transferred

TABLE 1—PHYSICAL PROPERTIES OF ANHYDRITE CEMENT			
	Max.	Min.	Avg.
Specific gravity	2.9	2.8	2.85
Weight of a liter in friable condition, in grams	780	680	700
Weight of a liter in densified condition, in grams	1,650	1,200	1,400
Fineness: Residue on sieve of 900 meshes per sq. cm. (76 meshes per lin. in.), in per cent	2	0.5	1.5
Residue on sieve of 4,900 meshes per sq. cm. (178 meshes per lin. in.), in per cent	30	12	20
Tensile Strength (1:3 Mortar), in kg. per sq. cm. (and lb. per sq. in.):			
After 7 da. storage in air	20 (284) *	10 (142) *	18 (256) *
After 28 da. storage in air	35 (493)	14 (199)	22 (313)
After 28 da. combined storage in air and water	12 (171)	7 (100)	8 (114)
Crushing Strength (1:3 Mortar), in kg. per sq. cm. (and lb. per sq. in.):			
After 7 da. storage in air	160 (2,275)	80 (1,140)	120 (1,710)
After 28 da. storage in air	320 (4,550)	100 (1,420)	180 (2,560)
After 28 da. combined storage in air and water	130 (1,850)	70 (995)	100 (1,420)
Tensile Strength (Neat Cement), in kg. per sq. cm. (and lb. per sq. in.):			
After 7 days	42 (597)	22 (313)	30 (427)
After 28 days	65 (925)	30 (427)	44 (626)
Crushing Strength (Neat Cement), in kg. per sq. cm. (and lb. per sq. in.):			
After 7 days	180 (2,560)	100 (1,420)	150 (2,135)
After 28 days	650 (9,250)	250 (3,550)	360 (5,120)

*Figures in parentheses are corresponding values in lb. per sq. in.

from a separate bunker to the mill, at the same time as the anhydrite, with the aid of feeding devices commonly used in cement manufacture. The use of a separator as a part of the grinding installation insures a proper degree of fineness.

The finished cement is transferred by means of a worm to a bucket elevator, which conveys it to the silos. The effective height of the silo must not exceed 15 ft., to avoid deterioration of the cement while in storage.

It should be added here that burning may also be accomplished in a rotary kiln.

Early Experimental Development

The production of gypsum-anhydrite cement under semi-plant conditions was organized in 1923-1924 by the Kineshma (R.S.F.S.R.) Chemical Works. A small ex-

	Age of Specimen			
	4 da.	7 da.	28 da.	2 mo.
Tensile strength (neat cement), in kg. per sq. cm.:				
Stored in air	25 (356) *	28 (398) *	35 (498) *	42 (597) *
Stored in water	10 (142)	15 (213)	22 (313)	16 (228)
Combined storage, in air and water	16 (228)	24 (341)	30 (427)	35 (498)
Tensile strength (1:3 standard sand mortar), in kg. per sq. cm.:				
Stored in air	20 (284)	25 (356)	26 (370)	28 (398)
Stored in water	5 (71)	4 (57)	4 (57)	4 (57)
Combined storage, in air and water	15 (213)	10 (142)	8 (114)	7 (100)
Crushing strength (1:3 standard sand mortar), in kg. per sq. cm.:				
Stored in air	129 (1,835)	186 (2,645)	160 (2,275)	180 (2,560)
Stored in water	100 (1,420)	98 (1,395)	54 (770)	40 (570)
Combined storage, in air and water	190 (2,700)	195 (2,775)	118 (1,680)	90 (1,280)

*Figures in parentheses are corresponding values in lb. per sq. in.

perimental plant was built in 1923-1924 at the chemical works of the State Textile Trust. All cement produced was used for the construction of workers' residences.

A plant was built in 1931 at Sterlitamak (Bashkir Republic), and enlarged in 1932.

A shaft kiln for the production of gypsum-anhydrite cement was built at the Kramatorskaja (Donetz Railway) Cement Works of the Ukrainian Cement Trust. Anhydrite cement has been produced at this plant and used in construction.

In 1934 a plant for the production of anhydrite cement began its work at Ufa.

PROPERTIES OF ANHYDRITE CEMENT

Normal Consistency: The normal consistency of cement paste is obtained with 35 to 40 per cent of water.

Setting Time: Initial set, from 30 min. to 1 hr. 30 min., final set, from 3 to 6 hr. from the beginning.

Soundness: The cement withstands the soundness test—heating of pats for 2 hr. at 120 deg. C. (248 deg. F.), and ten cycles of freezing and thawing during a period of 16 hr., freezing at —17 deg. C. (+1 deg. F.) and thawing at +20 deg. C. (+68 deg. F.).

Porosity: The volume porosity of set anhydrite cement after 4 days is about 35 per cent, and after 28 days it drops to 32 per cent.

Physical Properties: The highest, lowest, and average values for various physical properties determined from tests of anhydrite cement are shown in Table 1.

The strength of anhydrite cement depends on the temperature and on the time of burning of gypsum, and on the fineness of the cement.

Table 1 shows that combined storage (part time in air and part time in water) lowered the strength of the anhydrite cement. Table 2 verifies this point, since it also shows reduced strength with combined storage, and a decided reduction when stored in water for the full period of the test.

Theory of Hardening

The influence of different substances on the acceleration of the hydration of anhydrite can be explained by the ability of CaSO_4 to form complex compounds. It is possible that anhydrite crystals in the presence of water and salt form, on their surface, unstable complex hydrates which afterwards dissolve, according to the equation—



After the first hydration process, a second one begins—the setting. The setting can not be explained by hydration alone, for here re-crystallization also plays a part.

This theory is confirmed by the fact that tensile tests of a neat mixture of gypsum-anhydrite cement showed the results given in Table 3.

The variations in tensile strength shown in Table 3—as, for instance, the drop in strength after 8 hours—can

TABLE 3—TENSILE STRENGTH OF GYPSUM-ANHYDRITE CEMENT AT VARIOUS AGES

Age of specimen	Tensile strength, kg. per sq. cm.	Age of specimen	Tensile strength, kg. per sq. cm.
1 hr. _____	1.0 (14)	2 days _____	25.0 (356)
1.5 hr. _____	4.8 (68)	4 days _____	27.5 (391)
2.5 hr. _____	14.0 (200)	7 days _____	26.5 (377)
5 hr. _____	19.8 (282)	10 days _____	35.0 (498)
8 hr. _____	25.0 (356)	28 days _____	48.5 (690)
12 hr. _____	14.9 (212)	4 months _____	49.0 (697)

Figures in parentheses are corresponding values in lb. per sq. in.

be explained by the fact that, as has been stated, unstable complex hydrates are formed on the surface of the anhydrite crystals. This leads to a certain mechanical strength, which in this instance reached its maximum in about 8 hours. Then these unstable hydrates begin to decompose, and during the period of this decomposition a lowering of strength occurs. During the process of hydration and re-crystallization the cement acquires an increasing mechanical strength. In due time the catalyzer that had been added becomes isolated on the surface of the cement.

Applications of Gypsum-Anhydrite Cement

Gypsum-anhydrite cement is an "air-binding" material and is being applied to building construction above ground. It can be used for brick masonry and for plastering over lath in the form of mixtures with sand ranging from 1:1 to 1:3½ (by volume), the permissible thickness of plaster being 15 to 20 mm. (roughly, ½ to ¾ in.). Materials such as peat, chips, fibres, asbestos, and sawdust may be added to it.

Gypsum-anhydrite cement can also be used in concrete for floors, for the manufacture of hollow concrete brick,

slag-concrete blocks, and other unpretentious materials and structures.

In the Ukrainian Institute of the Silicate Industry there were conducted certain experiments on making concrete of 1:2:4 proportions, for which purpose Charkoff building sand, granite rubble and brick were used. Cubes 20 by 20 by 20 cm. in size (5.08 in.), when crushed with a hydraulic compression testing machine at the age of 2 months had an average strength of 77.8 kg. per sq. cm. (1,105 lb. per sq. in.). At the age of 3 months the strength was 105 kg. per sq. cm. (1,495 lb. per sq. in.).

For Insulating Materials and Construction

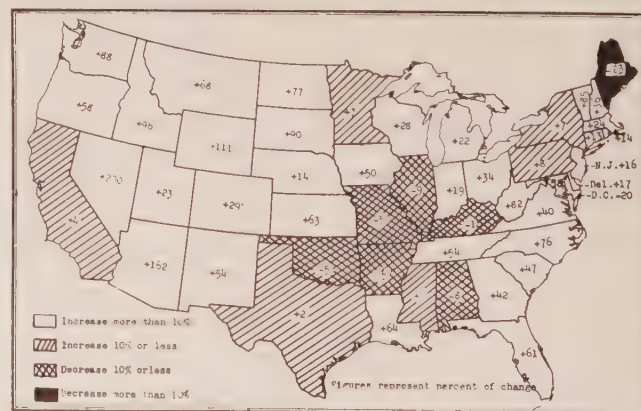
This cement can also be used for the manufacture of materials for thermal insulation and for the construction of floors, as a lining under linoleum, etc. Pigments can be introduced in the mass of cement, or finished products can be coated with them, oil colors adhering especially well. This cement is suitable for fresco work, for the manufacture of artificial marbles, and for splicing cast-iron and porcelain parts of insulators and similar products.

Gypsum-anhydrite cement, as previously stated, is being manufactured in the U.S.S.R. The United States of America, similarly to the U.S.S.R., is also rich with gypsum deposits. Therefore, I believe this account of my experiences with gypsum-anhydrite cement will be of lively interest to the American cement industry.

Literature: P. P. Budnikoff—Gypsum and its investigation. Publ. by the Academy of Science of the U.S.S.R. Leningrad 1933. Ibid., Russian Pat. No. 1,861 (1926); 4,153 (1924); 2,085 (1927). English Pat. No. 258,727 and 348,766 (1931); French Pat. No. 607,872. Belgium Pat. No. 330,683. Italian Pat. No. 250,688; D. R. Pat. No. 432,542; 420,957. P. P. Budnikoff, Chem. Ztg. No. 81, 1933, 801-803; No. 83, 822-823.

Cement Map Holding Gains

THE cement map of the United States for the period of 9 months ending September 30 continues to make a favorable comparison with the corresponding period of 1933. The following tabulation is interesting:



Period considered	Number of States	
	Reporting decrease	Reporting increase
12 months ending Dec. 31, 1933.....	34	14
6 months ending June 30, 1934.....	7	41
8 months ending Aug. 31, 1934.....	8	40
9 months ending Sept. 30, 1934.....	7	41

Declares Special Cement Committee Has Been Shelved

Specifications or No Specifications, Writer Asserts New Cements Have Come to Stay—Explains Distinction between Blended and Processed Cements

By ALTON J. BLANK

General Superintendent and Supervising Chemist,¹ Cementos Atoyac, S. A., Puebla, Puebla, Mexico

THE demand and need of new cements for normal and special purposes has been agitated by engineers and members of the construction trade for a number of years.

Progress along the lines of developing and marketing new cements has been retarded a great deal due to the obstacles that are being constantly placed in the way of any attempt to draw up specifications to cover the new cements, and the present onward trend toward the new all-purpose cements is being accomplished by overcoming to some extent the considerable objections of portland cement manufacturers.

Special Committee Represents Manufacturers' Group

However, as a result of the steadily increasing demands of the public for new cements, the American Society for Testing Materials, during the latter part of the year 1933, appointed a special committee to Committee C-1 to make a study of special and blended cements produced in the United States and elsewhere. For the benefit of those who have not gone into the matter, it may be stated that Cement Committee C-1 of the American Society for Testing Materials is composed of 81 members. Of this membership of 81, the producers are represented by 36 members, the consumers by 24 members, and the general interests by 21 members. However, the representation of Cement Committee C-1 notwithstanding, there were appointed to the special committee three members, and these three members were each producers of portland cement. No members representing the consumers or the general interests were named to this special committee, notwithstanding the fact that there are some very capable and experienced men representing these latter interests on Committee C-1.

On being appointed, the special committee was asked to make a study of new cements in particular, and blended cements generally, and the members were instructed to include in their studies the following:

- (a) The need for such cements.
- (b) The purpose which they will fill that is not filled by standard portland cement.
- (c) Available data as to the qualities of such cements.
- (d) Where they have been used.
- (e) The results obtained in actual use.
- (f) To report to the executive committee of Committee C-1 their views as to the need of Committee C-1 preparing specifications covering such cements.

¹ Also Chemical Director, Cement Process Corporation.

The Committee Is Shelved

At the March (1934) meeting of Committee C-1, due to the continued and emphatic objections raised by the portland cement manufacturers, it was agreed, generally, that any action with respect to specifications for new cements, as a whole, should be deferred for several years in view of the fact that further study of the new cements was necessary.

At the June (1934) meeting of Committee C-1 the wishes of the portland cement group were further acquiesced to, and it was decided that it would be impossible for the present to entertain views concerning tentative specifications for new cements in view of the little knowledge had of other cements than portland. Therefore, without the waste of further time, the question of new specifications for new cements was promptly and decisively shelved for *future* reference, with an accent on the *future*.

A New National Sport Emulated

In Mexico, during the present year, a new and popular sport, so-called, has developed for the entertainment of the public. This new feature has come to be known in



Private dam in Atoyac River, in State of Puebla, Mexico, is typical of many structures in which new processed cement is subjected to severe service conditions

sporting circles as the "Lucha Super Libre," and since its introduction it has almost achieved the popularity of the national sport, the "bull fight."

While somewhat difficult to describe, it may be said that the two contestants in the ring indulge in a combination of tactics that include ancient Grecian wrestling, present-day wrestling, catch-as-catch-can, boxing, football and the like. While a referee is in the ring for the pur-

pose of awarding the decision, it would appear that he is there for no other reason, since biting, gouging, kicking, tackling, hair-pulling and other methods of procedure in which no holds or blows are barred, are permitted each of the contestants; and since no such thing as a foul exists in the rules of the game, not only the winner and loser of the bout, but often the referee as well, are carried from the ring on stretchers.

From a first glance the above would appear to have nothing in common with cement; but, from recently published developments pertaining to the latter industry, and after one has made an analyses of the methods that have been employed by the cement industry in combating and preventing the drawing up of specifications for new and special cements, it would appear that this august group is well versed in the art and methods of combat employed in this so-called sport.

Going back into what is now ancient history, the writer, with the special committee of Committee C-1 by giving them his experience in the manufacture and use of blended cements in general, and his "Atoyac" cement in particular. In his report to the committee, composing some thirty pages, the writer went into considerable detail concerning the manufacture, qualities and uses of the several blended cements he had produced, together with his processed "Atoyac" cement, and compared them with the portland cements that are produced in the several plants where these special cements are produced.

Distinction between Processed and Blended Cements

There appears to be a considerable difference in opinion between the special committee of Cement Committee C-1 and the writer as to what composes a *processed* cement, and what is a *blended* cement.

The definition for *blended* cements, as arrived at by the executive committee of Committee C-1, is "two or more hydraulic materials ground together, one of which is portland cement clinker."

In this definition, the writer is not in agreement, particularly in view of the fact that this committee has taken the stand that "Atoyac" cement is a blended rather than a processed product.

Blended Cements Defined

Blended cements, as the writer understands them, may be composed of two or more types, wherein portland cements, or other types of cements may be blended together to yield a final product having certain definite and desirable properties or qualities not found in any of the cements utilized in making the blend, and which are obtained only when two or more cements are mixed together.

Or, blended cements may consist of mechanical mixtures of portland cement with limes, slags, ashes, tufas, puzzolanas, diatomites, and other materials of the calcareous-siliceous-argillaceous types such as sands, clays, carbonates and the like.

Typical of the first type of blend mentioned is that which has been used recently in the construction of Boulder Dam. In this case some four or five distinct brands of portland cement, manufactured in as many plants, have been blended together on the job before use to give a "low heat of hardening" product, a desirable property or quality that was apparently not found in any

of the four or five brands of portland cement used to form the blended product.

The second type of blended cement may consist in a mechanical mixture of portland cement with hydrated lime to give a product having great plasticity and water-proofing properties. Or it may consist in a mixture of portland cement and puzzolana, tufa, diatomite or the like, to yield a product having special resistance to sea water and alkali ground waters, or intermixing of portland cement with other ingredients to yield products having accelerated or delayed setting and hardening properties, high early strength, durability and the like. Such products, in the opinion of the writer, may be considered as blended cements.

And These Are Processed Cements

In the development of the "Atoyac" type of cements the writer found that by hydrating lime in the presence of diatomaceous earth and grinding the mixture under controlled moisture, temperature and fineness conditions, that under favorable conditions of control a hydraulic cement having normal setting properties and strength qualities that attained those of portland cement at the 28-day test period, was obtained. He further found that by using varying amounts of portland cement clinker as an admixture at the grinding stage of the procedure, a product definitely superior to standard portland cement was obtained. By substituting sands, clays and the like for diatomaceous earth, and reacting these materials with lime during the hydrating procedure, and grinding with varying amounts of portland cement clinker under the controls of moisture, temperature and fineness, it was found that any number of special cements for special purposes could be manufactured by varying the kinds and properties of the materials used and the control during the manufacturing procedure.

The use of catalyzers such as calcium chloride, sodium chloride and carbonates, tannic acid, etc., dissolved in minute quantities in the water used in hydrating the lime during the hydrating and grinding procedures of the process, resulted in other definite and desired properties and qualities being obtained in the resulting products.

Produced by following the process as outlined above, the cements are as surely processed cements as are portland and other cements manufactured by following a certain procedure, and can not be classed with, or as, the blended type.

Those who are in a position to inform the public as to why they believe portland cement to be superior to the new and special cements that are now on the market should base their conclusions upon facts, not merely on beliefs. Condemnation of a new cement for the sole reason that it competes with the standard portland cement that has held sway for so long, does not suffice.

William H. Caffery, 79, founder of the Bonner Portland Cement Co., Bonner Springs, Kan., and the Kansas City Portland Cement Co., was buried on November 6.

Henry F. G. Wulf, president and general manager of the Monarch Cement Company, Humboldt, Kansas, died suddenly on October 19 following a heart attack at his office desk.

EDITORIAL

Twenty Years of Accident Prevention

Just twenty years ago the cement industry inaugurated its accident-prevention campaign—a movement that was destined to gain for this industry the leading position among all the industrial groups engaged in this humanitarian work.

Few people, aside from the wheel-horses who have been in the thick of this fight from the early days, realize the magnitude of the results accomplished—results far beyond the dreams of the most optimistic friends of industrial safety.

Consider, as a single accomplishment, that the lost-time accident toll in 1914, in 41 cement manufacturing plants, reached the appalling total of 3,920, including 60 fatalities. In contrast, the year 1933 saw only 120 lost-time accidents in 110 reporting plants. Of these, only 7 were fatal.

It is unfortunate that public recognition can not be given to all the men who planned and directed this great work. Eighty-one men have given active service on the Portland Cement Association's committee on accident-prevention and insurance. Notable among these is Henry A. Reninger (Lehigh), who served for the full 20-year period from 1915 to the present time. Six others have served more than ten years. These are A. F. Krabbe (Olympic), with a service of 15 years; G. F. Bayle, Jr. (Glens Falls), 13 years; and W. R. Dunn (Vulcanite), A. C. Tagge (Canada), D. N. Armstrong (Missouri), and William Moeller (Texas), 11 years each.

Recognition is due also to the Association men who served at various times in the direction of this work—men like Schaffer, Jacobson and Curtis—who, through personal contact with the men at the plants, gained the latter's confidence and co-operation.

Then, in the final analysis, it was only because of the energy and enthusiasm of the men on the firing line—the plant superintendents and foremen—that the accident-prevention movement could be developed to a full measure of effectiveness. It was they who made possible the amazing records of individual plants.

A Good Word for the Small Kiln

During a recent private conversation a well-known designer of cement-making machinery expressed the opinion that some plant managements have gone too far toward mere bigness in rotary kilns.

He was referring in particular to plants of small or moderate capacity whose only burning equipment consists of one or two large kilns. A plant with only two kilns has but little flexibility. It can operate

only at full or at half capacity. A plant with only one kiln has no operating flexibility whatever. In periods of low output it is compelled to operate intermittently, running all departments at full capacity for a time, then shutting everything down.

By way of contrast, one of the most successful cement plants in the country is equipped with 14 small kilns having a combined annual capacity of about 3,000,000 barrels. This plant has a maximum of operating flexibility. During periods of low output all departments can be operated continuously, slowed down to the pace set by a few small kilns.

The huge rotary kilns installed in recent years have their advantages—for the big plant. Managers of plants of small or moderate size should keep in mind the need for a sufficient number of burning units to maintain flexibility in operations.

The Biggest Since 1928

One of the best things that can be said about the thirty-second annual meeting of the Portland Cement Association, just held in Chicago, is that the attendance was the largest since 1928; but best of all was the optimistic spirit that prevailed—a spirit that could easily be detected in the general atmosphere as well as in the countenance of individuals.

The cement industry is looking forward toward bigger things in 1935; and this vision of better times is based on something far more substantial than hope.

Seven Years Without an Accident

The Iola plant of the Lehigh Portland Cement Co. has made the incredible record of operating seven consecutive years without a lost-time accident.

Six others—the Iron-ton plant of Alpha, the Exshaw plant of Canada, the Trinity plant at Fort Worth, and the Medusa plants at Toledo, York and Manitowoc—have operated four consecutive years without accident. The Thousand-Day Club now has a plant membership of nearly twenty.

Such records would have been thought wholly impossible twenty years ago, when the cement industry started its campaign for reduction of accidents. During that year—it was in 1914—41 plants averaged more than 95 lost-time accidents to every plant, and fatalities averaged three for every two plants.

A little quiet reflection over the figures of twenty years ago will lead to a thorough appreciation of what these individual cement manufacturing plants have accomplished toward the elimination of human grief and waste.

had accident 6 City July 1930
Trinity Aug 1932

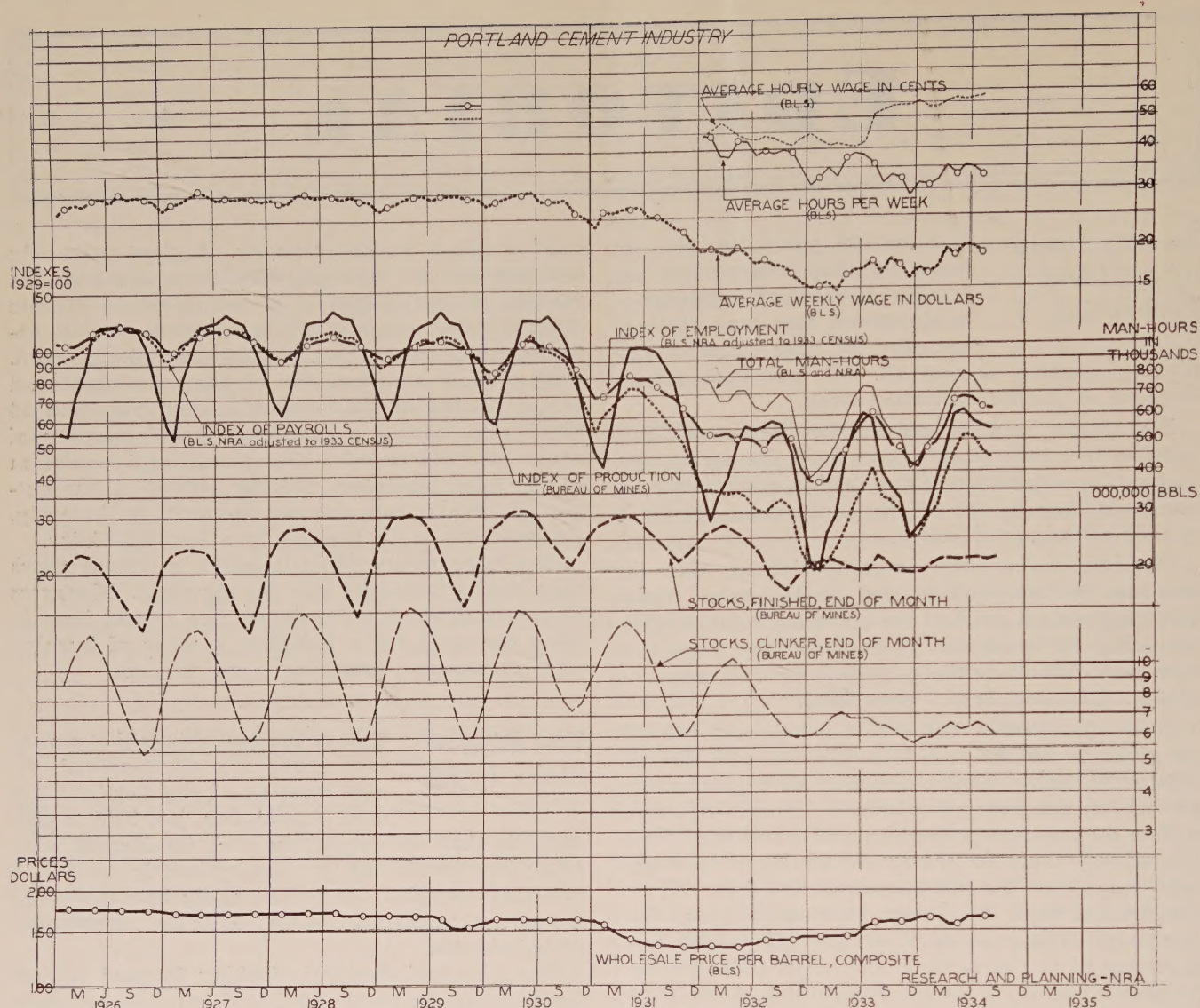


Chart prepared by the Research and Planning Division of NRA

Recent Trends in Portland Cement Industry

BOTH the current situation and the broad trend of the portland cement industry can be conveniently analyzed by means of the four indexes of activity in the central portion of the chart here illustrated. Three of the four indexes are expressed in terms of their respective averages in 1929, but the man-hour series is shown in actual numbers. The production series represents the entire output of finished portland cement in the United States as compiled by the Bureau of Mines. The employment and pay roll indexes are the Bureau of Labor Statistics indexes which have been adjusted (by NRA) to the 1933 totals recently released by the Bureau of the Census. The man-hour series was derived by multiplying total employment by the average hours worked per week, the latter series being shown in the upper section of the chart.

Employment in the portland cement industry in September 1934 was about 63 per cent of the average for 1929; while pay rolls were scarcely 45 per cent. Both indexes, however, made the best showing for any Sep-

tember since 1931. The tendency for pay rolls to recover more rapidly than employment since the middle of 1933, is explained by the fact that since then average weekly wages have had a rising trend in spite of the smaller average number of hours worked. Average hourly wages, shown in the upper section of the chart, are considerably higher than in late 1929.

Man-hours have moved parallel with production, but have been less stable than the index of employment, because the broad trend of average hours per week has been downward since early 1932 as a result of efforts to share work.

The production index represents the output of finished portland cement—that is to say, portland cement that has been ground, but not the quantity of clinker produced. But activity in this semi-finished (clinker) stage of the industry is reflected in man-hours. September production of finished portland cement was considerably greater than a year ago.—From *Blue Eagle*, November 12, 1934.

More and Broader Markets

Annual Gathering of Cement Men Is Largest Since 1928—Old and New Markets to Be Pushed—Architectural Concrete and Water and Soil Conservation Among Newer Developments

THE thirty-second annual meeting of the Portland Cement Association, held at the Blackstone Hotel, in Chicago, on November 19, 20 and 21, drew a larger attendance than any similar meeting since 1928. It was learned, too, that this meeting saw the presence of a number of cement men who never before had attended an annual meeting of the Association.

The feeling of optimism that prevailed was in marked contrast to the temper of previous annual meetings of the past three or four years. Doubtless the general change for the better in the mental attitude of business men and industrialists that has been so evident during the past month had much to do with this improved morale of the cement industry representatives. Doubtless, too, the improved sentiment was in part due to the manner in which cement shipments have been holding up near their mid-summer levels.

Promotion Sessions

The promotional sessions of November 20 were devoted to a well organized presentation of the vast program of activities in which the Association is engaged. The outlook and the strategy for 1935 were presented most convincingly. Clearly, the Association is in its fighting clothes and is prepared to push the further development of existing markets as well as the opening of new ones.

The field organization of the Association and the manner in which the field engineers operate out on the firing lines were described at the opening of the morning session by C. D. Franks, manager of the midwest offices, and by W. F. Lockhardt, field engineer, New York office.

Highway and Conservation Work

M. H. Small, district engineer at Kansas City, described the Kansas PWA loan-and-grant highway program—one of the most comprehensive and best organized of all state highway programs in 1934. The work in Kansas involved not only the organization of a construction program, but it was necessary to adopt an amendment to the state constitution in order that the PWA loan might legally be accepted.

The lessons of the droughts of the past five years and what is to be done about them, were set forth by A. F. Unkrich, chief field engineer for Ohio, who discussed water and soil conservation as a future market. In point of actual work accomplished, as well as in the adoption of enabling legislation, the state of Ohio takes the lead. This is another instance where numerous construction projects of small size—no one project requiring much concrete work—will utilize a large combined volume of cement and concrete. Some of this construction work involves projects of considerable size, requiring imposing quantities of concrete.

How publicity will help to sell concrete was explained

by J. R. Fairman, manager of the eastern offices.

New Development Program

The program planned for the development of new markets was conducted under the leadership of Frank T. Sheets, director of development, who outlined the scope of the program. In leading off the series of discussions, A. A. Anderson described his study of high joints in concrete pavements, their causes and their prevention. Entry of water into the joints, causing swelling of the subgrade soil (and freezing in cold climates), was found to be the cause. The remedy, quite obviously, is found in the sealing of the joints to prevent the entry of water, and in the proper preparation of subgrades.

Adaptability of concrete to small building and house construction was discussed by R. E. Copeland. Color in concrete was the subject covered by C. W. Planje, who told of the technical studies being made as a preliminary to the later development of the practical application of scientific facts being developed. New developments in paving design were discussed by Frank T. Sheets, who explained the engineering principles involved and the manner in which these principles are brought to the attention of highway engineers.

Architectural Concrete

A. J. Boase, manager of the structural and technical bureau, told of the comprehensive program of development in the architectural uses of concrete, and the steps taken by the Association toward the training of construction men in the matter of working procedure. It is well known by all who have studied the subject that the placing of architectural concrete requires greater refinement than that ordinarily employed in placing structural concrete.

An enormous volume of concrete work is seen as the ultimate goal in the field of architectural concrete—a goal that will also bring better and more economical buildings.

From the Patent Office

Acid and waterproof cement: Foster Dee Snell, Brooklyn, New York. U. S. Pat. 1,973,731.—The improvement in the manufacture of acid and waterproof cements by the mixing of silicious material and sodium silicate consists of increasing the hardness and density of the cement by adding to the silicious material aluminum hydrate to form an aluminum silicate in said cement.

Cement: Foster Dee Snell, Brooklyn, New York. U. S. Pat. 1,973,732.—The cement composition capable of setting to an acid proof and waterproof product comprises a dry mixture of ground aggregate, a readily soluble powdered sodium silicate and sodium fluosilicate in a proportion which completely neutralizes the sodium oxide of the silicate, said silicate mixture being completely soluble in water and capable of being applied before setting commences.

Two Decades of Safety

By A. J. R. CURTIS

Asst. to General Manager, Portland Cement Association, Chicago, Ill.

TODAY we pass an important milestone in the history of the cement industry. It marks a fifth of a century of progress in one of our noblest and most significant activities—that of banishing accidental injury and death with attendant misery and misfortune, from those who labor in cement mills and quarries.

The safety activities of the Portland Cement Association during twenty years have won our industry a place of very high honor for its humanitarian stand in putting safety ahead of output or profits, or any other consideration.

Beginning of Safety Movement

The year of 1912 is recorded as the beginning of the organized safety movement in this country. In that year, also, the Accident Prevention Committee of the Cement Association came into being under the chairmanship of John B. Lober, and with the following members: R. S. Sinclair, W. S. Mallory, J. G. Bergquist, F. R. Bissell and Percy H. Wilson. These men started from scratch, with no prior experience to guide them; but at the fall meeting in 1914 their diligence resulted in the presentation of the accident records of 41 cement plants covering twelve months of operation. This report revealed a total of 3,920 lost-time or more serious accidents, of which 60 were fatal.

Just twenty years ago the fight against accidents in the cement industry began in earnest. The Bureau of Accident Prevention and Insurance, under the direction of a full-time manager on the Association staff, began its work at this time. At the end of the first year a quarterly reporting system had been established, safety rule books were available to members, 29 mills had received personal visits. Following publication of the 1915 statistical report, the U. S. Bureau of Labor Statistics commented on this work as unmatched by that of any other industry in the country.

Each year brought increased enthusiasm and greater participation among the members. In 1919 the first regional safety and welfare meeting was held at Bethlehem, Penna., with 70 representatives in attendance. Regional meetings from that time on became a definite part of the activities program.

Drop from 3,920 to 148

Perhaps the most spectacular activity, one that has brought invaluable good will to the industry as well as positive measurable results in safety, was inaugurated in 1923, when the Portland Cement Association Trophy was offered.

Our first objective was, of course, to reduce the number and severity of all accidental injuries. This is a continuing objective and the ultimate will not be achieved until accidents are entirely eliminated. As an industry we have reduced the number of accidents occurring annually from 3,920, reported 20 years ago, to 148 in 1933. This reduction is even greater than these figures indicate, because of the greater number of mills now reporting.

Big Improvement in Last Ten Years

In 1924, 110 plants reporting their man-hours, had 3,098 lost-time accidents and a rate of 35.3 accidents per million hours. There were 60 fatalities in that year. In 1933, 116 plants had 120 lost-time accidents and a rate of 4.6 accidents per million hours. There were *seven* fatalities. The cement industry now stands second among all industries as reported by the National Safety Council in low accident frequency, and for several years we stood in first place.

Until 1924, no plants had operated an entire year without an accident. Last year, 61 plants which burned clinker more than six months had perfect safety records.

Seven Years without Accident

Individual plants are setting undreamed-of records. The Iola, Kansas, plant of Lehigh has now operated more than *seven consecutive years* without an accident. The following plants have recorded more than *four consecutive years* without an accident: Alpha, Ironton; Canada, Exshaw; Manitowoc; Medusa, both Toledo and York (white); Trinity, Fort Worth. Many others have four or more perfect but not consecutive years. The Thousand-Day Club now has nearly 20 members.

The basis of these unusual plant records lies with the individual employee. We now have in our files the records of 21 men who have served in the operating end of the portland cement industry for more than 30 years without causing injury to themselves or others. We also have the names of more than 400 men with better than 20 years, and 2,000 men with better than 10 years of perfect safe working history.

Surely we have something to celebrate in our 20th anniversary of safety work. Our material rewards have been noticeably reflected in decreased compensation and medical expense. Above all—and by far the most gratifying result—is the security and protection from tragedy which has come to thousands of homes.

Col. Reninger Is Honored

Col. Henry A. Reninger, of the Lehigh Portland Cement Co., Allentown, Penna., received formal recognition of his leadership in the humanitarian field of accident prevention when, on November 21, he was awarded the Holmes Safety Certificate.

Presentation of the certificate was made by Dan Harrington, safety engineer, United States Bureau of Mines, at a luncheon during the annual meeting of the Portland Cement Association in Chicago.

Unemployment Insurance

The National Industrial Conference Board, 247 Park Avenue, New York, has published a pamphlet entitled "Unemployment Insurance: Lessons from British Experience." The study begins with the British law of 1911, which introduced compulsory unemployment insurance, and concludes with a summary of the Act of 1934.